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ABSTRACT

This three volume report describes a study that addressed the potential impact of information technology (IT)-based educational technology on the challenges facing the continuing education and vocational, industrial, and professional training sector of the Commission of European Communities member countries, and appropriate leading-edge applications of the products of advanced IT for evaluation and training. The Executive Summary highlights key aspects of the purpose, conduct, and findings of the study, which utilized questionnaires, case studies, literature reviews, preparation of an educational technology scenario for the 1990s, and a meeting of experts from the 10 commission countries. The main report discusses the study details, as well as the technology of education and training, its current applications and costs, opportunities for advanced educational technology, some obstacles to the introduction and appropriate use of IT, and a proposed strategy. Annexes to the report include a statistical summary of questionnaire responses; a list of site visits; questionnaires used with employers of trained manpower, educators and coordinators, and IT-manufacturers and service providers; a five-page primary documentation list; a case study of the use of computer-assisted instruction at the Credit Agricole; and transcripts of a 1984 meeting on the Future of Information Technology in Education and Training. (LMM)

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OPPORTUNITIES FOR INFORMATION TECHNOLOGY-BASED ADVANCED EDUCATIONAL TECHNOLOGIES

Final Report for the Commission of European Communities

Volume 1 : Executive Summary

May 1984

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Case study in the use of IT for training
Contributions to a meeting of experts

Acknowledgements

PREFACE

This Report contains the final results and conclusions of a six-month study commissioned by the Information Technology Task Force of the CEC. It is presented in 3 separate volumes:

Volume 1 : Executive Summary
Volume 2 : Main Report
Volume 3 : Annexes

The work under the contract has been undertaken by a team comprising: Dr Peter Zorkoczy (Project Director), Dr Paul Bacsich, Dr Tony Bates, Dr Diana Laurillard, Dr Tim O'Shea and Prof J J Sparkes, with the assistance of Maurice Geller and Carolyn Shaddick, and with contributions by Dr Tony Kaye and Jane Henry.

1. INTRODUCTION

This section reviews the rationale, objectives, scope and approach of the Study.

1.1 Rationale

This Study has been motivated by two urgent questions:

a) what impact can IT-based educational technology make, over the next 10-15 years on the challenges facing the education and training sector of the Member Countries?

b) what appropriate leading-edge applications exist, within education and training, for the products of advanced IT now being developed in Europe?

Although answers to these questions are being sought by educational, training, governmental and other bodies in most Western countries, the present study, along with several others, takes a Community-level, rather than a Member State-level approach. This is being done while realizing that there is great diversity in the curricula, pedagogical aspects and, of course, the languages of the Member States which makes a common solution unrealistic, even if it can be shown to be desirable. Nevertheless, it has been assumed from the outset that there are common elements to the problems, and to the solutions (not least in the area of the technology used by education and training). An important aim of the project was, therefore, to identify and build upon these common elements.

In looking for possible answers to the two questions posed above, we were also conscious of the various initiatives that are already being taken in this field both by individual Member States, and for the Commission. Our purpose, through the recommendations which we make in the last Section of this Report, has been to complement and reinforce these initiatives, so that targeted action by the Commission adds further value to the individual national and commercial initiatives.

1.2 Objectives

More specifically, the objectives of the investigation were:

- to explore the needs and requirements of education and training between now and the 1990's;

- to look forward to the products and services of information technology which may be available and/or required by education and training in the 1990's;

- to examine the current state of usage, and reasons for usage, of IT-based education and training systems, with a view to assessing the trends, experience with, and costs of introduction of such systems;

- to expose the future plans and needs of the providers of education and training, together with their perceptions of problems in the future use of IT-based methods;

- to assess the economic aspects of IT-based education and training;

- to put forward specific recommendations for action by the Commission aimed at stimulating and assisting in the research, development, provision and appropriate use of advanced IT-based educational technologies.

1.3 Scope

Within the severe limitations of time and resources, it was necessary to restrict the scope of the investigation to vocational, professional and continuing education and to industrial training, and thus specifically exclude general primary and secondary education. We have also restricted the scope of the project to the 10 member states of the European Community, even though we are aware of the considerable amount of relevant work and initiatives in the United States, Canada, Japan and some other countries.

1.4 Approach

The approach taken to satisfying the objectives of the project involved a number of parallel strands:

a) identification and contacting of organisations, firms and individuals who are known to be active in, or are known to have an official role in, or were expected to have a direct interest in the use of information technology in education or training.

Table 1 of the Annex shows the distribution of contacts made by means of an initial letter describing the aims of the project.

Over 90% of these initial contacts replied positively, indicating willingness to participate in the project. All these respondents were sent a detailed set of questions around which they were invited to express their views, experiences and future plans relating to educational/training uses of IT. (These questionnaires are reproduced in the Annex.) A computer database, with

keyword coding, has been built up for the management of the contacts. The results and conclusions reported here are based on the analysis of over a 150 completed questionnaires, the breakdown of which is given in Table 2 of the Annex.

b) case studies and personal visits to a selected number of contacts for an in-depth exploration of issues which the written responses identified as important. The list of these visits is given in the Annex.

c) review of the state-of-the-art in the use of IT for education and training, and of future intentions, based on publications and other documentation. A list of the key reports noted in this area is given in the Annex. Additionally, we have accumulated over 100 relevant documents in this area. The conclusions drawn from the review are incorporated into this report.

d) preparation of an educational technology scenario for the 1990's. This is also incorporated into the text below.

e) the organisation of a meeting of experts from all 10 countries of the Community on the topic of the study. A transcript of the contributions made at the meeting is presented in the Annex; conclusions and recommendations from the meeting are incorporated into the text of this report, in particular into Sections 5, 6

2. CHALLENGES FOR EDUCATION AND TRAINING

2.1 The socio-technical environment in which education and training operate, is in the state of rapid change, as a result of:

- scientific and technological developments,
- the 'information explosion',
- employment policies of national governments and employers,
- changing expectations, etc.

2.2 Educated and skilled manpower represents a strategic resource. Total expenditure on E&T in the Member States is estimated to be around 6 1/2% of GNP, and affects everyone in one form or another.

2.3 A significant increase in demand for continuing and adult education and vocational training can be expected over the next 5-10 years (Para 2.3.1).*

Curriculum changes must reflect the new technologies, the re-structuring and mobility of employment, the short time-span of many skills, the importance of communication and life skills, etc. (Para 2.3.1.)

Structurally, information technology has already affected the educational and training sector through the emergence of distance education and of commercial E&T companies based on electronic media (Para 2.3.2.).

*Para numbers refer to paragraphs of the Main Report.

3. THE TECHNOLOGY OF EDUCATION AND TRAINING, ITS CURRENT APPLICATIONS AND COSTS

3.1 We review computing, video, audio, telecommunication and added-value services (Paras 3.1.1 - 3.1.9).

3.2-3.3 Applications reviewed in some detail include:

- broadcasting (Para 3.2.1),
- cable and satellite TV (Para 3.2.2),
- video-cassettes (Para 3.2.3),
- interactive video (Para 3.2.4),
- computer-based learning and training (Para 3.3).

3.4 Our brief review of the costs of IT-based training has suggested that it is expensive to develop, has low marginal costs and is most cost-effective with large student numbers. With low student numbers it may offer added value for added costs, in certain circumstances. The chief savings are through cost avoidance, from reduced accommodation and travel expenses and (some claim) manpower savings through course compression. However, the evidence for these claims is limited.

Many of our respondents felt a need for more information on the cost-benefit of IT-based training. Other studies echo this plea, notwithstanding the well recognised difficulties of measuring learning outcomes, obtaining the full costs and finding companies agreeable to reveal this information. Several people also pointed out that they had enough information on theoretical costings. Since development times seem to vary widely and cost effectiveness in one area does not necessarily transfer to different sectors, what is needed is a series of case studies of particular IT applications, used for a variety of purposes in different sorts of organisations and industries.

Our review also indicated that development costs of IT-based E&T systems are high, particularly so in the case of computer-aided learning and training materials. It is, therefore, important to distribute these costs over a large user population, and to make the process more efficient (Para 3.4).

3.5 Reasons for using IT in education and training, as given by our respondents include:

- improved quality of learning, achieved through interactivity, immediacy, individualization, richer learning environment, increased motivation, etc. (Para 3.5.1);

- possibility of new learning opportunities and access (multi-media distance learning, learning by the handicapped and disadvantaged, etc.) (Para 3.5.2);

- ability to satisfy a larger demand at reduced unit costs (Para 3.5.4);

- more efficient management of the learning process (Para 3.5.3);

- scope for consistency and standardisation of learning materials (Para 3.5.3);

- aids to rapid production and updating of learning materials (Para 3.5.3);

- commonality of educational technology, in spite of national differences in the curricula and organisation of education and training (Para 3.5.4);

3.6 We divide the education and training sectors into:

- a 'formal' sector comprising institutions of education and training, all commercial training companies, and the training sections of non-E&T organisations and companies, and;

- an 'informal' sector, made up of individuals spending disposable income on education/training related products and services.

We estimate the value of this sector at about 100,000 million ECU (based on 1978 prices - the last year for which figures are available) for the Community countries (Para 3.6).

We conclude from the responses received to our questions, that the size of the E&T market is likely to increase, at least in terms of the numbers of people involved, if not in terms of its value (at fixed prices) (Para 3.6.1).

4. OPPORTUNITIES FOR ADVANCED EDUCATIONAL TECHNOLOGY

4.1 We expect the next stage in the development of educational technology to be a move towards multi-media, distributed learning systems. By this we mean a development of distance learning systems, involving print, video, audio, and computer-based materials, aiding the learner and the instructor. The development is towards the individualisation of the materials, allowing to be tailored to local and personal requirements (Para 4.1).

4.2 In particular, we expect a considerable increase in the volume and expenditure on computer-based training (Para 4.2).

4.3 We present a technological scenario for the 1990's which concentrates on the components of multi-media distributed learning systems. Likely technological developments in computing, telecommunications and value-added services are linked in our scenario to expectations towards technology, expressed by our respondents (Para 4.3).

5. SOME OBSTACLES TO THE INTRODUCTION AND APPROPRIATE USE OF IT

We have grouped the points made to us on this subject under the headings of:

a) Educational problems - primarily related to curriculum issues, educational methods/techniques and course material (including courseware).

b) Technological problems - primarily related to educational/training aids, equipment and software

c) Structural/organisational problems - affecting the whole field of educational technology.

d) Resourcing problems - costs and investment issues.

5.1 Educational problems

5.1.1 Lack of co-ordinated information on the availability and effectiveness of educational/training aids ("what is available, who is using it and for whom, how was effectiveness measured").

5.1.2 "Problems of different sectors of education and training are different, i.e. no single solution or single product likely to satisfy all needs."

5.1.3 Lack of solid theoretical foundation for teaching/learning and the appropriate use of media, in particular computer-aided learning.

5.1.4 Lack of professionals with the necessary combination of skills to exploit technological aids (learning psychology and educational technology).

5.1.5 Slow integration of IT-based systems into teacher training curricula; thus resources that are already there are not fully exploited ('Subtraction problem': what to remove from curriculum to allow more time for IT?)

5.1.6 Lack of sufficient high-quality, well-documented course materials which could be used to demonstrate the advantages of IT-based methods. The few good systems are mostly in English.

5.1.7 Fears of de-socializing effects of individualised learning techniques (e.g. computer-aided learning, computer-based training).

5.2 Technological problems

It is apparent from virtually all responses that technological obstacles are not considered to be of primary significance. The following three points, however, appeared sufficiently frequently for them to be included here:

5.2.1 Lack of cheap, easy-to-use, reliable and flexible aids to learning.

5.2.2 No adequate technical facilities (primarily, software tools) available to educators and trainers to make rapid, easy, low-cost changes to existing courseware.

5.2.3 Transferability of courseware is difficult due to differences in languages, lack of standards, diversity of percieved needs. This also inhibits transfer of good practices, and re-use of modules.

5.3 Structural/organisational problems.

5.3.1 Fragmentation of the educational/training sector - no identifiable community of qualified educational (information) technologists; no identifiable market for manufacturers to sell into, leading to a lack of interest in the sector by large manufacturers, lack of an organised user representation at international level.

5.3.2 Institutional inertia and mistrust of new technologies, both in education and in industry. Organisational problems in introducing new methods, even when management is willing.

5.3.3 Lack of intellectual rights legislation to protect software and courseware.

5.4 Resource problems

5.4.1 "The start-up problem" : high initial costs of equipment and courseware creation, as an 'add-on' to existing facilities, lead to cash-flow problems.

5.4.2 Lack of convincing cost-effectiveness information or even of measures of it.

5.4.3 Educational and, particularly, industrial training are not financially highly rewarding either for trainers or for the manufacturing/service sections. This leads to a shortage of high-quality manpower and convincing products.

5.4.4 High development costs for manufacturers and service providers.

6. A PROPOSED STRATEGY

In this concluding section we wish to put forward a synthesis of the ideas which have emerged from our Study, in the form of a set of coherent actions, for implementation over a period of about five years.

6.1 Aims

The aim of the strategy is to stimulate the appropriate use of IT-based educational and training systems by providing 'added-value' and a 'European dimension' to the various national initiatives. In particular, support from the Commission should focus on:

1) a programme of basic research on the appropriate use of technology as an aid to learning;

2) encouraging co-operation, and the spread of good practices and products among the national education and training sectors;

3) identifying and giving initial support to new developments (products and services) which are cost-effective only when implemented on a multi-national scale;

4) ensuring that the educational and training sectors, as one of the most important application areas of information technology, can make a significant contribution to, and derive a signficant benefit from, the full range of European initiatives in information technology R&D and application.

6.2 Approach

To achieve these aims we recommend the following approach

a) In relation to Aim 1, we recommend a programme of research and development projects, outlined in greater detail in Section 6.4 below. An important feature of this programme is that it involves not only the design and development of new products (based on the recommendations of Working Groups) but also their direct application in achieving specific educational and training objectives, through the production of educational materials.

b) In relation to Aim 2, we recommend the setting up of a number of specialist working groups to deal with the technical and economic issues (identification of needs, specification of products and services, their evaluation, etc.) of advanced educational technology. These should involve experts from both the educational and training

sectors. We also recommend that individuals and groups who are involved in the working groups and in the implementation of this strategy should be interlinked by a communication network (e.g. by participation in Eurokom) which provides electronic mail/computer conferencing facilities.

We further recommend the publication of a series of 'guides of good practice', cost-effectiveness studies, reviews and assessments of products, as outputs from the working groups, or as commissioned studies, or as part of the documentation of contracts placed by the Commission in this field. There are to be up-dated to include the results of projects under a) above.

c) In relation to Aim 3, we recommend an emphasis on educational and training problems and applications in some of the areas of activity of ESPRIT, in particular in:

- advanced information processing systems (as aids to learning, knowledge representation, communications, storage and retrieval of information, etc);
- office systems (many educational and training systems have an administrative component);
- infrastructures (support and co-ordination).
- micro-electronic and software engineering developments. These are relevant in reducing the cost and improving the effectiveness of IT-based authoring and presentation systems.

Overall, we recommend an approach which is based on the exploitation of existing hardware and the emerging software aids, in conjunction with advanced communication facilities, and combined with a programme of basic research and system definition. Co-ordinated work along these lines will lead to a new generation of learning aids by the end of a 5-year time span.

6.3 Framework

We believe that advanced educational technology will make its most noticeable impact in promoting distributed learning.

By distributed learning we mean learning which may, but need not necessarily, take place in an institutional setting, and which gives substantial control of timing, learning strategy, and location to the learner. It combines distance learning, personalised learning, and open learning. It offers the

possibilities of independent or small-group learning, in a multi-media environment.

The table below shows some of the activities involved in distributed learning, and the role of technological aids in these activities.

The main advantages of distributed learning accrue to thelearner in increased flexibility and better access to high-quality learning materials. But the educator/trainer also gains by being able to tailor available learning materials to local requirements, and being able to offer a rich learning environment which actively involves and motivates the learner. The main contribution of IT is to make distributed learning effective.

6.4 A programme of research and development

As a move towards distributed learning, and towards the appropriate use of advanced educational technology more generally, we recommend a phased programme consisting of:

Phase 1 (1984/1985)

1) the development of learning materials based on existing technologies, but in the distributed learning mode in, for example:

   - a "Hands-on introduction to the Use of IT in Education/Training" (for training the trainers/teachers)

   - the use of IT-based tools in industry, management, office, retailing, etc.

   - basic vocational subjects, etc.

   The preparation of such materials will inevitably expose some of the problems and needs of the 'state-of-the-art' technology and point the way towards desirable future developments.

   We recommend that such learning materials should be developed by joint teams from academia and industry/business. Their distribution on a Community scale (where appropriate) should be organised and resourced from Community funds.

ACTIVITIES IN DISTRIBUTED LEARNING

	ACTIVITY TYPE	TECHNOLOGICAL AIDS
I	Educational materials development process	
1.	Identification of needs (employers, government, learners, educators), market research.	1. Interactive databases, low-speed communications networks, teleconferencing.
2.	Development of objectives, curriculum, test strategy, etc.	2. Communication support for trainers. Tools for the representation of knowledge and skills. Databases of curricula and proven materials electronic libraries.
3.	Resource organisation and management.	3. Management tools (decision-making project control), office automation.
4.	Selection and delivery of existing learning materials.	4. Databases on availability, quality, costs etc., of existing materials. Computer-ised production of text.
5.	Production/modification and testing/validation of new learning materials. Documentation.	5. Multi-media production systems (text, data, voice, picture).
6.	Presentation.	6. "Workstations", (personal text, voice, picture, data systems) linked to networks, e.g. by cellular radio broad-band cable, etc. Repair and maintenance aids. Multi-media books.
7.	Evaluation and improve-ment of materials.	7. Remote CML, on-line updating.
II	Tutoring, guidance counselling	Computer-managed learning. Tele-conferencing (real-time). Tutored video (small groups). Electronic mail.
III	Administration	Computer/communication-based registration, testing, progress, fees systems
IV	Support services	Electronic libraries. Aids for handicapped.

2) The drawing up of design specifications (by Technical Working Groups convened by the Commission), followed by a Design Competition for :

a) an educational workstation

b) improved human-computer interface devices, e.g. speech input/inter-active audio; overhead electronic screen and pointing device based on gesture; "electronic book", a European educational/training user interface;

c) European standard telephone modem capable of handling both data and speech simultaneously on one line, at low cost;

d) aids to the creation of high-quality portable courseware.

3) The initiation of a programme of basic research into:

- cognitive processes in IT-mediated learning
- appropriate and inappropriate uses of IT in learning
- the social and educational effects of media (e.g. in individualised learning, group learning)
- 'intelligent' authoring systems.

Phase 2 (1985-1989)

1) The development, prototyping, testing, manufacture and diversification of educational/training systems based on the products designed in Phase 1.

2) The continuation of the programme of basic research started in Phase 1.

3) The setting up and maintenance of "electronic libraries" of courseware and other learning aids.

4) The development of courses of Community interest exploitation of new learning aids and systems e.g. in:

- community languages
- skills required or brought about by the application of products developed under ESPRIT

- the training of educational information technologists, etc.

5) The exploitation of new telecommunications services for education and training purposes (e.g. professional updating), electronic mail, teleconferencing.

6) The development of cost/effectiveness assessment techniques, and their application to projects undertaken within the programme.

7) The continuation of the work of Technical Working Groups on the definition and evaluation of new products developed for the E&T market, and the assessment of products of relevance initially aimed at other markets.

8) The exchange of personnel between educational and industrial environments; joint meetings, and dissemination of new developments.

6.5 Resourcing

We recommend that Commission support be provided for the above programme by :

a)	design competition	20%)	
b)	joint industry/academic projects including the development and production of learning materials	50%)))	of total cost
c)	academic projects	100%)	
d)	distribution of learning materials of Community-wide interest	100%)	

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2. CHALLENGES FOR EDUCATION AND TRAINING

In this Section we review the evidence available to us on the changing expectations towards education and training in the Community, and examine some of the implications of both fulfilling and not fulfilling those expectations.

2.1 Changing environment for education and training

The educational and training (E&T) sector has a vital role to play in modern society in supplying the human resources required, and in satisfying the aspirations of individual members of society. The conditions which determine the nature of these requirements and aspirations are in the state of rapid change under the influence of many factors, including:

- the rapid advance of scientific and technological development,
- the rapid increase in information and knowledge,
- the changing socio-economic environment,
- the employment policies of national governments and employers, etc.

To provide a reference point for the changing scene we shall first present some data relating to the E&T sector of the Community.

2.2 The current state

The Member States have a population of around 275 million (expected to grow to 280 million by the year 2000). Approximately 100 million are under 25 years of age (Source: Economic Survey of Europe, 1982). The working population is around 105 million, with unemployment, in August 1983, at 11.6 million.

Some 60 million pupils and students were in full-time education in 1980/81, which represents 72% of the 5-24 year age group, an increase of 4.5% of this age group over 1970/71. By assuming a staff/student ratio of 1:30, there were about 2 million teachers.

Of the 16-24 year ago group in 1976, approximately 8% were receiving higher education, as compared with 14% in Japan, and 20% in the United States. The average length of formal education ranged from 11.5 years in Germany to 15.6 years in Belgium, and compared with 14 years in Japan and 17 years in the United States (Source: OECD).

Government expenditure on education and training in the nine Member States in 1978 (the last year for which figures are available) was, on average, 5.4% of GNP. This was equivalent to £55.3 billion, or £267 per head of the population aged 5-64 years (see table below).

Table 1 : Government expenditure on education and training (1978)

	% GDP	Exp.per head in purchasing power standards (PPS)	Total exp in ECU's (billions)	Total exp. in national currency (billions)
EEC(9)	5.4	402	83.7	—
NE	7.6	584	7.8	21.5 HFL
BG	7.2	557	5.3	213.4 BFR
IR	6.7	301	0.6	.4 IRL
UK	5.7	398	14.0	9.3 UKL
DK	5.6	499	2.5	17.7 DKR
FR	5.2	442	19.4	111.5 FR
LX	5.0	405	0.1	5.4 LFR
GDR	4.8	424	24.4	62.4 DM
IT	4.7	269	9.6	10.3 KLIT

Source: EEC (CEDEFOP & OECD)

Vocational training accounted for some 16% of this figure, on average, but ranged from 3% in Italy, to 28% in France.

With expenditure on training by employers (about 2.5% of wage bill) and on privately financed education, we estimate that the educational and training sector absorbs some 6.5% - 7% of the Community's GNP.

In terms of economic activity, the E&T sector involves, primarily, all institutions of education (school, colleges, universities), commercial training organisations, the training sections of the entire non-E&T sector, governmental and other administrative bodies in this field. More widely, the sector closely interacts with fields like publishing and printing, education equipment manufacturers and service providers, broadcasting and others. In terms of its output the sector, of course, affects all walks of life.

These considerations imply that the E&T sector also forms an important market for other sectors of the economy. We shall return to this point, and its implications for the IT manufacturing and service sector, at the end of Section 3 of our report.

2.3 The effects of change

We shall comment on the expected effects of the changes listed in 2.1 under the headings of

- educational and training considerations,
- structural and organisational aspects,
- the technology of education and training,
- resource issues.

As the latter two points form the focus of the present study, we shall devote the entire next section to them. Here we shall concentrate on the first two points.

2.3.1 Educational and training considerations

On the basis of the comments from our respondents, we expect major changes in the numbers of those receiving education and training, in the curriculum, as well as in the educational methods used to convey the content.

While the numbers of those receiving full-time education follow the demographic fluctuations, a significant increase in demand for education and training is expected in the fields of continuing, part-time, and informal E&T.

This includes :

- adult (continuing) education
- professional up-dating
- re-training and re-skilling
- vocational up-grading
- public awareness
- leisure and community courses, etc.

Estimates of the numbers involved in part-time E&T are not available; however, they could easily exceed the numbers in full-time education, which would at least double the present number of 60 million participants.

Expected changes in curriculum reflect the expectations of the effects of changes in society and technology as a whole.

These changes include :

- an increasing level of competition for world markets,
- the re-distribution of labour and relative population numbers, including regional unemployment, mobility of labour, etc.

- energy and natural resource costs and availability,

- increasing automation of traditional production processes,

- increasing expenditure on and technological development of defence systems,

- the expectation of continuing change, etc.

In this context, the products of new technologies, including man-made materials, new manufacturing methods, bio-technology, space technology, and of course, information technology are being rapidly developed and exploited.

Information technology, in particular, is being looked towards as a means of increased productivity and wealth generation, not requiring significant raw material and energy input, but rather emphasizing the use of intellectual, organisational (managerial) and new technological skills and expertise, at the expense of manual or unskilled employment.

The rise of the new technologies has already created shortages of certain skills which Western countries are at present having to satisfy by rapid re-training, competitive employment practices, or by recruiting from third-world countries (thereby depleting the skilled manpower resources of those countries).

Examples include 'information system engineers' - graduates with digital electronic and computing experience, with an ability to convert system requirements into marketable products; systems analysts; managers and other professionals with a good grounding in technology, electronic engineers, etc. The education and training sector is finding it difficult to provide an adequate and rapid response to these needs, not least because of a shortage of teachers and trainers with the necessary technological background.

There is no stability, however, in regard to either the quantity or the duration of the need, or even in the particular mix of skills needed for the new technologies in the years to come.

Many of our respondents emphasized the likely future short time-span of marketable skills. This poses a particular challenge to the E&T sector, in terms of its ability to recognise and respond to emerging needs in a cost-effective way.

A further challenge is presented by the re-structuring of employment. This problem has been vividly expressed by George Tolley (in : "Education, Training and the New Technologies", Kogan Page, 1984):

"We are still nowhere near moving from the 50-50-50 structure (in terms of working years, weeks and hours) to a 40-40-40 structure, and I should have thought that in order to sustain economic and social stability we have got to move to 30-30-30 within 10 years". Preparing people and sustaining them for this kind of life is yet to be faced by the world of E&T.

In the meantime, the more immediate challenge is the potential mobility of labour, in terms of skills, industries and location of employment. In view of the regional and national differences in unemployment, and the development of new working opportunities in new locations and new industries, education and training are in an enabling role, allowing those who wish, and are prepared, to make the necessary transition.

A further problem arises for the large number of small businesses in Europe: how to train their staff at low cost and without losing their services for prolonged periods.

Given the rapidly changing social and technological scene, there has been a considerable emphasis on the flexibility of skills and knowledge to be acquired by the current generation of learners. In practice, this means concentration on basic and transferable skills, an ability to learn and to handle information, an ability to communicate and operate effectively as part of a team.

Some of our respondents put particular stress on the importance of these life skills and communication skills as components of the modern curriculum.

Another area of concern to our respondents was management education and training. Here the vital importance of familiarity with information technology for office, production, design, communication and other organisational activities was noted.

However, the most immediate and major challenge to E&T was widely perceived to be the training of teachers and trainers in the understanding and exploitation of information technology and, in particular, of the emerging educational technologies, and in being able to respond to the changing demands of society and the individual learner.

2.3.2 Structural and organisational aspects

Perhaps the most relevant developments brought about by the changing needs of society and the new information technologies have been distance learning and the emergence of commercial (private) educational and training companies in Europe. (In the United States both these developments have occurred earlier, and now operate on a large scale.)

In distance learning, the learner has great flexibility in relation to the location of studies, as the system relies on pre-prepared and pre-delivered learning materials (supplemented, as necessary, by local tutoring and counselling support). With large numbers and with an efficient, centralised materials preparation and administrative system, distance learning has proved to be a cost-effective and popular method of learning.

In the case of the Open Universities of some of the Member Countries, distance learning concepts have been coupled with open learning. This meant the extension of access to educational facilities for those who, through lack of opportunities or formal entry qualifications, have previously been unable to participate in further or higher education.

A further degree of freedom, that of timing, is gained by the learner in independent learning, where only minimal structured support is provided institutionally, or by tutors/trainers during the learning period. Instead the learner works with prepared materials, exploits appropriate sources of information, and organizes the use of time.

As this mode of learning is more appropriate for those who have already 'learned how to learn', and who can provide their own motivation, a more group-work orientated version has also gained ground, particularly in the UK: supported self-study. Here learners work together, with the help of a tutor, if necessary. An example of this is 'tutored video instruction' (TVI) which involves the use of video-taped presentations by a small group of, usually advanced, learners in a stop-start mode, with instantaneous discussion of points of interest/concern.

The challenge that these new modes of learning, and their use by enterprising commercial education and training companies, present to institutional learning is a fundamental one: they respond to the requirements of the adult learner, and, just as importantly, of his/her employer.

An effective response to these challenges involves not only changes to the curriculum, the preparation, delivery and testing of learning materials, but also changes to the administrative, assessment and validation and other support structures of educational and training bodies. Information technology can serve as an effective aid to making an effective response in each of these spheres.

The alternative to making an effective response to the changes outlined in 2.1 has been outlined recently by E. Pogrow ("Education in the Computer Age", Sage Publications, 1983):

"a process wherein dissatisfied constituents ... abandon the organisation for an alternative, economically compelling service made possible by a fundamentally new technology".

On an even broader scale, the inability of an educational system to cope with the changing numbers, skill requirements, preferred learning modes, cost constraints, etc. of its clients and customers can degrade a fundamental strategic resource. It deprives industry, business and commerce of the skills that they require to stand up to an increasingly fierce international competition.

3. THE TECHNOLOGY OF EDUCATION AND TRAINING, ITS CURRENT APPLICATIONS AND COSTS

3.1 State-of-the-art in Information Technology Relevant to E&T

3.1.1 Computing

Hardware:

Personal computers installed by 1983 are estimated at 30 million worldwide, and are forecast to reach 80 million by 1987.

In UK, 300,000 BBC micros have been sold so far, 25% of which are estimated to have disc drive and dot-matrix printer.

Second-processors for 8-bit machines and the more recent 16-bit (and pseudo-32-bit) machines will allow main memory to reach 65K-128K, allowing a high-resolution colour screen display to be maintained, without noticeable penalty for main processing. Dedicated (application) processors are also becoming available for tasks like voice interfacing, communication handling, databse, etc. Graphic and text (multiple) windows are also becoming available on PC's, together with programmable ("soft") keys, as a result of faster larger main-memory processors.

Screen interaction is now widespread, using light-pen, joy-stick, 'mouse' and (in a few cases) touch-screen. Icon representation is available for different programs on systems such as Apple's Lisa.

Interfaces for printer, A/D-D/A, discs (including hard discs), synchronous and asynchronous communication (including modems and local networking) are becoming available as standard (i.e. manufacturer-independent).

Software:

Software for personal computers is tending towards interaction and packaging of several application programs (e.g. Lotus 1-2-3) and increasing exploitation of graphic facilities provided by hardware (e.g. ExecuVision for IBM PC).

Portability of languages is increasing. Techniques used include intermediate codes (such as p-code) or computer kernel (common elements of major high-level languages) plus pre-compiler for each language. (Hardware compatibility via post-compiler linking kernel to processor instruction sets.)

Operating systems are also moving towards industry standards; in particular CP/M and its derivatives for 8-bit, UNIX and its versions for 16-bit, and MS-DOS for IBM PC lookalikes.

Japanese are introducing a common standard for their major manufacturers, called MSX.

3.1.2 Video and audio

Video:

Digital signal processing in TV sets is making it possible to achieve higher horizontal resolution. Stereo TV sound is about to be introduced in new TV sets. (Two audio tracks have been available in VCR's and discs for some time.) No standard has as yet emerged for this. VHS is emerging as de-facto VCR standard. Portable camera-recorders are becoming available e.g. Sony's Betamovie system is hand-held. Maximum playing time has been increased to 16 hours.

In UK, about 30% of households were estimated to have VCR's in 1983.

For video-discs, laser players have remained more interactive, but more expensive, than the capacitance (CED) players. Arcade-game devices exploit CED players with computer graphics superimposed e.g. MysteryDisk and Maze Mania in U.S.

Audio:

In 1983, compact digital discs, based on the laser video disc principle, were introduced (Philips and Sony co-production). Manufacturers are promising recording, as well as replay discs, and are preparing their use in computers as high-capacity read-only memory.

The 'compact (optical) disc' (CD) introduced by Philips and Sony, is primarily for the audio entertainment market, but also is a possible substitute for 'read-only' computer storage.

A common standard, agreed by Philips with Japanese manufacturers, envisages a 4 1/2-inch laser-read disc, capable of holding 55 Mbytes (approx. 270,000 sheets of A4 typesript). This development, called by Philips the CD-rom, brings the prospect of a single player for audio, video and computer data.

3.1.3 Communications (basic services)

Voice:

The telephone system is well developed (although overall EEC business and residential penetration are both only some 65% of that in the US; Italy and Ireland are well behind the others). Subscriber trunk dialling and international direct dialling are widespread.

Problems affecting the use of voice telephony in education are:

- poor (and variably poor) speech quality
- excessive likelihood of failure of an already connected call.

The two criticisms that business also makes, those of
a) excessive percentage of failed/misrouted calls and
b) excessively long call set-up times,

we have regarded as less significant limitations for education, with its more leisurely timescales.

Educational use: distance education makes significant use of the telephone for tutorial and counselling purposes.

3.1.4 Data communications

Telex/teletex:

Telex is a traditional and well-developed network in the EEC as elsewhere (e.g. about 100,000 customers in Britain alone). Its main business disadvantage is the slow speed of network (5 characters per second), but since telex is hardly used in education, the slow speed can hardly be said to be a further disadvantage!

Teletex is a newer version of telex, using intelligent terminals operating at 2400 bps (240 characters per second). The service has been specified by CCITT, and terminals have just started to appear on the market.

Educational use: minimal.

Low-speed data services:

By this we mean services up to 9600 bps (960 characters per second).

Dial-up access:

In most EEC countries users can buy or rent modems giving them access to the telephone network at data rates of up to 1200 bps (although in many countries these modems can only be rented from the PTT). Such modems are now available at prices down to £40.

Switched data networks:

The Euronet packet switched network has been operational now for some years, and now connects all EEC countries including Greece.

Most countries also have their own national packet switched network, interworking with Euronet (e.g. PSS in the UK, Transpac in France; also Germany, Belgium, Luxemburg). These networks allow users to gain access to remote computers at less than the long-distance telephone charge.

Private data networks:

For several years organisations have been able to rent a private circuit from one building of their organisation to another, possibly many miles away. With rare exceptions such as banks, different organisations have not been allowed by PTTs to interconnect their networks.

Educational use: Most large organisations, including educational organisations, will make use of some of these facilities. In particular, library staff access remote databases through Euronet. Specifically educational uses are relatively rare, being largely confined to such organisations as the Open University.

High-speed data services:

By this we mean services operating at between 64000 bps and 2 million bps.

In several countries, organisations can rent private data circuits at such data rates (e.g. the Kilostream and Megastream services in the UK). No switched service is yet available.

Specific educational use is nil.

3.1.5 Broadband services

By this we mean services operating around 140 million bps (i.e. capable of carrying an uncompressed colour TV channel). Such services are not yet available on a public basis. However, trial systems are being built, e.g. BIGFON in Germany, Biarritz in France.

3.1.6 Satellite services

There are a few experimental satellite-delivered data services. In particular, OTS was launched in 1978 and has been used in Project Universe. The EUTELSAT organisation oversees European space communications, and launched its first satellite in 1983.

3.1.7 Radio communications

Radio paging:

This is available around city areas in several European countries. Educational relevance is nil at present.

Radio telephony:

This technology has been used for years by ships and aeroplanes, and certain public service organisations, but the vision of a public access radio telephony service has always foundered on problems of frequency spectrum availability. (One might also suspect that socio-political factors have played a role - compare the European and American approach to Citizens Band Radio.)

Currently, new-generation "cellular" radio systems (which minimise frequency congestion) are under development in a number of European countries.

Educational use: nil at present, but perhaps because there was nothing to use. Certainly some educational commentators have seen a role for such a service.

3.1.8 Cable television

Cable television (including community antenna systems) is quite extensive in Belgium, Holland, and Denmark but has low penetration in other EEC countries. Installation of additional cable capacity is being actively pursued in Britain (11 new franchises have been granted), and to a lesser extent in France and Germany.

Educational use: nil at present; but many commentators see considerable educational potential.

3.1.9 Added-value services

Audio-teleconferencing:

Although this is quite common in the US, it is little used in Europe.

Specific educational use in Europe is unknown, apart from some limited use in Britain. The main obstacles are basically everything - in particular :

- the lack of suitable loudspeaking telephones;
- the lack of good quality bridging equipment;

- poor quality of the telephone network;
- lack of PTT enthusiasm for the service;
- PTT regulatory problems (e.g. interconnection of private and public teleconferencing networks).

Educational use: Some use in Britain by the Open University and a couple of other organisations.

Videotex:

Most EEC countries have a public viewdata service or are running viewdata service trials. Only Britain, France and Holland have a public service, although Germany will do so shortly. There are also a considerable number of private viewdata systems, for example in the travel industry. The number of terminals is still fairly low, e.g. even in Britain it is still only 45 000 as of April 1984.

Educational uses: This is surprisingly small. In the UK, Barclays Bank are carrying out staff training. Upcoming uses by educational organisations are essentially for educational administration; even the Open University only runs an experimental system at present for its own internal use. However, a national, educational database of UK higher education courses information is being developed at the Open University under a grant from the UK Department of Education.

Facsimile:

This is still an analogue method of sending photographs and diagrams over the telephone network, although digital systems are being developed.

Educational use is nil.

Electronic mail:

Although electronic mail is quite widely used in the US, and there are a few educational applications, it is little used in Europe. Most viewdata systems in fact offer a simple mail system, but it is not promoted as such. In Britain the PTT offers a public electronic mail service, Telecom Gold, and a number of private suppliers (e.g. Istel, AP Sharp) are entering the market.

Many large organisations of course have their own electronic mail network for internal use; however, there has been PTT pressure to restrict access by external users, and there is

still great PTT hostility to international use of mail systems (an aspect of the so-called "trans-border data flow" problem).

Educational use: Given the above, you will not be surprised to read that it is effectively nil.

Value Added Networks:

It is now possible in one country of the EEC (namely Britain) for private organisations to provide data network services to third parties. A number of organisations including some European ones (e.g. Istel - formerly British Leyland Systems) and some long-standing American ones (e.g. ADP) are now doing so. (Curiously, for some years time-sharing and viewdata bureaus have been offering suspiciously similar serives - it seems that provided the electronic mail aspect was not too overt, one did not fall foul of regulatory pressures.)

Educational use: Currently nil.

3.2 Television

In recent years, technological developments have led to greater diversification of IT-based systems, widening their range and potential for education and training. We shall therefore look at current broadcasting, cable TV, satellite TV, video cassette, and video-disc and cumputer applications in some detail.

3.2.1 Broadcasting

Broadcasting's history in E&T dates back over 60 years to the BBC's first schools radio broadcasts in 1924. In Britain alone, during term-time there will be over 80 hours a week of nationally networked educational broadcasts, covering schools, continuing education and Open University programmes. While no other country in the world has such a wide range of originally-produced, nationwide educational broadcasting, educational broadcasting is substantial in a number of other European countries, particularly West Germany, Denmark and Holland.

However, in Western Europe broadcasting organisations are independent, primarily concerned with broad coverage, if not mass audiences. Consequently, they do not normally provide programming aimed at specific areas of vocational or professional training. Even so, there have been a number of interesting developments in these areas in recent years.

Both in Holland and Britain, there have been broadcast series aimed at improving computer literacy. The BBC's Computer Literacy series are particularly important, because they illustrate the power of broadcasting to promote understanding of

information Technology in the general public. To provide a common machine on which viewers could work when following the series, the BBC specially commissioned the design and manufacture of a low-cost British microcomputer, which incorporated a number of interesting features (such as the ability to receive and store broadcast telesoftware). The public demand for this micro outstripped all estimates, and more than 300,000 machines were sold in the first two years. At the same time, the Department of Education and Science chose this machine as one of the two for which half funding would be provided if schools found the other half.

The BBC Computer Literacy programmes frequently reach more than one million viewers, and the National Extension College provides correspondence courses and a text-book to help students to learn BASIC programming on the BBC Micro. Many colleges of further education run courses around the television series, and the BBC has also encouraged the formation of local user clubs.

European broadcasting organisations have for many years used broadcasting to support in-service teacher training, but more recently several broadcasting organisations have also started introducing series for managers and accountants. The BBC a number of years ago, ran a television series for Trades Union members and officials, and in several European countries there have been broadcast series aimed at foremen and supervisors, concerned primarily with man-management issues.

However, there is now a growing recognition that broadcasting is a weak instructional medium on its own, and needs to be reinforced by other media, such as print and face-to-face teaching. At the same time, because it reaches into almost every home and because it is heavily used by all sectors of society, broadcast television is highly effective in raising awareness of developments in and implications of information technology and of the need for re-training in industry. It is also excellent as a means of recruitment to other forms of training.

The importance of using broadcasting as one component of a multi-media teaching system has resulted in the development of a number of organisational models for creating multi-media teaching materials. The organisational implications of this are discussed later, but at this point it is worth mentioning the British Open University, which uses broadcasting extensively as part of its teaching system, and which is currently engaged on a major programme of continuing education and first degree work in the field of industrial training. As well as undergraduate courses on electronics, computing systems, design, and optics, all of which have broadcasting components, the OU

also offers non-graduate courses on management education, in-service teacher training and post-graduate engineering. Many of these non- graduate courses also use broadcasting, primarily for recruitment and enrichment purposes.

Nevertheless, broadcasting has had a limited role in industrial or commercial education and training, mainly because of the requirement on broadcasting organisations to serve the public at large, and because of its inappropriateness for teaching specific skills through the broadcast medium alone (for a full review of broadcasting in education and training, see Bates, 1984).

3.2.2 Cable and Satellite TV

Although cable and satellite can be used independently for education and training, they can - and indeed often are - used in combination, so they will be dealt with together in this section.

There is probably no greater variation in the availability of any technology throughout Europe as cable, from less than 20% of homes connected in Britain and Germany to over 80% in Belgium. Futhermore, regulation of cable varies equally widely from country to country. This means that the educational potential of cable will also differ, from the potentially unfavourable de-regulated and commercially based systems in Britain to the strongly regulated systems in France. Also, to date there is relatively little experience of using cable TV for education and training purposes in Europe. What is clear is that cable access will grow rapidly in Europe, and there are already clear indicators of what roles it could play in education and training, and of the factors that may inhibit its development.

The future of satellite TV for education and training is even less certain, and equally varied from country to country. Here a distinction must be made between low-powered communications satellites, which require larger and more expensive receiving equipment but which are eminently suitable for networking independent cable stations (thus facilitating national schedules); and high-powered direct broadcast satellites (DBS), which require smaller and cheaper reception equipment, and are suitable for domestic reception, again on a national basis. Given the current estimated cost of providing a DBS channel (around 2 million ECUs per annum, without programming costs), given also the estimated cost of the reception equipment (around 1000 ECUs per home), and the limitation of five DBS channels per European nation, it is hard to see DBS being used extensively for education and training purposes. Pan-European satellite services are further bedevilled by language difficulties, even though several audio channels can be made available.

There is a good deal of experience in North America in using both cable and satellite for education and training purposes. However, great caution is needed in extrapolating from North American experience to Europe. Geographical, cultural, linguistic and communication factors are all different. Cable developed initially in North America because of the impossibility of providing a trans-continental transmission network and because of poor reception from often local and low-powered transmitters, hampered by long distances between communities, or by mountain ranges, or skyscraper buildings. Because of the large land-mass and the very small number of countries sharing the same longitudinal and latitudinal positions in the Northern hemisphere of the Americas, it is possible for each country to have many more national satellite channels than in Europe. Indeed, the allocation of satellite channels is not currently limited in North America by international agreement, (unlike Europe) and Canada is planning to have at least 50 DBS channels and the USA 80! Lastly, because of the availability in Europe of rental arrangements, and, it must be said, the quality of broadcast transmissions, video cassette usage is much more widespread in Europe than North America, providing an alternative choice of programming to cable or satellite. With these reservations in mind, some of the ways in which cable and satellite have been used in education and training to date will be described.

Both cable and satellite can of course be used merely as an alternative way of transmitting broadcast programmes - indeed that is their prime function regarding entertainment programmes. However, used in an educational or training context, cable and, to a lesser extent, satellites have a number of advantages over terrestrial broadcasting.

The most interesting use of cable and satellite has been by Knowledge Network, in British Columbia, Canada. This is a provincial government educational communications agency, with a remit to provide transmission facilities throughout the province for all educational institutions within the province. Through government regulation, Knowledge Network has access to one channel on all the cable systems throughout the province. In addition, it has access to one channel on Anik-3, a direct broadcast satellite operated by the Canadian Federal Government (again access is through government regulation), for which Knowledge Network pays only $370,000 (about 400,000 ECU's) per annum. Programmes can therefore be received either directly in homes in the more isolated parts of the province, or picked up by each of the local cable stations. In this way, about 90% of homes in British Columbia can be reached, with some spin-over also into Alberta, North-West Territory, the Yukon, and Washington State, U.S.A. Also, Knowledge Network operates a broadband, two-way communications system between two

Universities, the five teaching hospitals, and the law courts in Vancouver.

Much more interesting though than the distribution system is the actual use made of it. Because of having a complete, dedicated channel of 98 hours a week transmission, and because it is a service agency to other educational institutions, Knowledge Network has been able to develop new forms of programming which exploit the unique characteristics of cable. This means that programmes can be longer in length than conventional broadcasts, using local lecturers as well as bought-in material, and live interaction with students, through viewers calling in to ask questions of experts or to participate in studio discussions, via the public telephone system. While of course this could be done technically using ordinary broadcasts, the range of channels available through cable (there are 15 in Vancouver) allows for such programming to be directed to specific audiences (narrow casting). Knowledge Network has produced a number of interactive cable programmes in vocational training. For instance, it ran a series to train part-time fire-fighters in the more isolated regions of the province.

It is important to note though the heavy public funding of both the Knowledge Network and the Anik-3 satellite. Knowledge Network is unique in that it is currently the only on-going system in education based entirely on cable and satellite distribution, although a number of systems use cable and satellite to enhance broadcast transmission (e.g. TV Ontario).

There have been a number of experimental satellite projects. The largest - and certainly the most impressive - was the Indian SITE experiment, which in 1978 brought television to villages in parts of India where modern communications were previously unknown. This project required the development of low-cost aerials and television monitors located in villages and the construction of up-link transmitters to the American ATS-6 satellite. The facility of several sound channels was used to provide different language versions in each of the areas covered by the satellite. The one-year project was a remarkable technological achievement (especially given the enormous problems of introducing such technology in remote areas of India), so much so that India will put up its own educational satellite very shortly.

However, two points should be noted. It was only a demonstration project - at the end of the experimental period, the Americans manoeuvred their satellite to a new position, leaving the villagers once again without modern communications. Secondly, while the project was also educationally successful, the supply of a sufficient number of programmes of adequate quality proved to be a major problem. One of the major lessons

learned from this experiment was that just as much, if not more, attention has to be paid to courseware as to the technology itself.

A number of other satellite experiments in education have been tried. In the Appalachian Mountain States in the U.S.A., the ATS-6 satellite was used to provide in-service training for teachers in isolated communities. On this project, the ATS-3 satellite was also used for two-way radio communication between the teachers and the centre at the university of Kentucky in Lexington. A similar project was carried out in health education and careers education in Alaska. In both cases, Universities or teaching hospitals were involved, bringing their services to remote communities. Once again, however, these were demonstration projects, not on-going systems.

With regard to cable, the number of educational and training uses in Europe to date is minimal. Canal Emploi, based around Liege in Belgium, is a local cable channel which provides programming aimed at young, unemployed adults. In London, the Department of Trade and Industry has financed (at a cost of nearly 2 million ECU's) the installation of a broadband television cable and microwave system to link two major teaching hospitals' lecture theatres with lecture theatres in a number of other hospitals scattered around West London. This scheme becomes operational in September, 1984. However, there are few other European developments in education and training via cable.

Even in the U.S.A., the use of cable for education and training purposes is in practice much less frequent than one might expect. Lewis (1983) in a comprehensive survey of post-secondary institutions in the U.S.A., found less than 30 using cable TV for educational purposes, and only one of these (in Reading, Pennsylvania) used full two-way video. Most were merely distribution systems for college-based lectures. Some companies, like American Express, are now producing company magazines on video, which are carried on local cable channels, aimed at information and up-dating company employees, while at the same time promoting the company's image. These levels of "sponsored" training/advertising programmes are likely to become more common on cable systems which have minimal public regulation or public financing for education and training programmes.

The potential of cable for education and training has not yet been really exploited. Even on co-axial cable systems, low-bandwidth two-way communication could be made possible. This would allow viewers to make simple multiple-choice responses, vote for alternative endings for programmes, or order educational or training materials. Using the public telephone system, natural voice interaction with live programming is also

possible (as at Knowledge Network). . Local institutions could make available existing video materials for distribution, or, if they have their own production facilities, they could relay lectures, studio discussions or other forms of low-cost production. For new cable systems exploiting fibre-optic technology, a wider range of viewer interaction is possible. Keyboard responses to programme material is then possible. Perhaps the most exciting development of all is the interactive video-disc library available via cable, being developed by British Telecom. Such a system would allow local users to down-load not only the video-disc material on to their own monitors, but also to access computer data via their local microcomputers or terminals, allowing for full interactive control of the video discs.

However, the financial barriers to the use of cable for education and training are substantial. In a local area, there may well not be enough subscribers to an educational channel to warrant provision of such a special service, particularly if it is a premium service (i.e. if viewers have to pay an extra subscription for the educational service over and above the basic cable subscription rate). Highly interactive services are almost certainly to be at a premium rate. Full two-way video, even on fibre-optic systems, will be very expensive - probably too expensive for most education and training purposes. It is also significant that large educational organisations which originally had fixed cable systems, such as the Inner London Education Authority and many colleges, have abandoned such systems for the greater flexibility of video-cassette distribution.

The future for cable then for education and training is at this moment ambivalent. The achievement to date is nothing to become excited about, and its future depends very much on the extent to which governments or industries are prepared to legislate for, or financially support educational and training applications on cable.

3.2.3 Video-Cassettes

In our survey video-cassettes were by far and away the most common technology used to date in education and training. Several reasons seemed to be given for this.

1) Widespread availability of production facilities and professional production staff, both in-house and in commercial production companies. This has resulted in a wide range of material for education and training, much of which can be bought off-the-shelf.

2) Technological developments of two kinds:

- a considerable reduction in recent years in the costs and complexity of cameras, lighting equipment and video editing facilities, accompanied by major improvements in technical quality. This means that relatively low-cost productions of high technical quality can now be made to meet specific training needs.

- a considerable reduction in the cost of replay equipment (i.e. VCR's) and tape in recent years, leading to low distribution costs of video.

3) The appropriateness of video for certain education and training tasks.

Many companies are now using video not only for marketing, advertising and in-house communication, but also for training purposes. The British Royal Navy for instance is using video-cassettes for on-board training on ships at sea, reducing the need for operational seamen to receive land-based training. Automobile manufacturers, such as Austin Leyland, have set up "drop-in" centres near the factory floor where workers can learn about new manufacturing procedures via video-cassettes. Philips in Holland is using video-cassettes to train its managers to use office-based computer systems. Several multi-national oil companies are using video for training rig operatives on North Sea oil and gas installations. Some medical consultants are using video recordings of a 'normal' inner ear as a means of comparison with the patients' inner ear. The Open University is moving more and more of its programmes away from broadcasting to video-cassettes, both for cost and effectiveness reasons. Many more examples could be given.

Video-cassettes are likely to remain a major component of education and training, even given the development of other technologies such as video-discs, cable TV and computer-based training, for a number of reasons:

1) Video-cassettes can be used to record off-air broadcasts, thus making available to education a wide range of educational material produced by broadcast organisations at no extra cost to education institutions.

2) Video-cassettes can be wiped and re-used, thereby reducing distribution costs, and adaptations, selections, or amendments to be made locally.

3) Video-cassette machines are fast becoming established as a normal piece of household equipment, making video a practical medium for house-based distance education and training.

4) Video-cassettes provide learners with far greater control than broadcasts. Cassettes can be stopped, rewound, viewed several times, and used when convenient to the learner. Cassettes therefore can be used for mastery of skills.

5) Video-cassettes are cheaper and easier to produce, and more user-friendly, than either computer-instruction or interactive video-discs.

6) Video-discs have superior control features to video-cassettes, and can be more easily controlled by computer, but their economic viability is still uncertain.

At the moment, training materials on video-cassette are still dominated by styles of production and utilisation inherited from broadcasting. Many programmes are continuous in format, last for 30 or 50 minutes in length, and require little active response from viewers. More and more though, and especially in the training field, course designers are beginning to exploit the unique characteristics of video-cassettes. Production styles which encourage the viewer to stop the cassette and review the previous segment, or carry out some activity, are becomming more frequent. By no means all useful learning activities have to be carried out through a computer keyboard. Written answers, reading, hand sketches, group discussion, operation of equipment, personal lectures are all activities which can be integrated with cassette viewing. Video-cassettes are therefore a very flexible medium, and their place in education and training seem very secure. Video-discs may eventually replace cassettes, but certainly not in the foreseeable future. It is much more likely that cassettes and discs will operate more and more in parallel.

3.2.4 Interactive Video

Interactive video (IV) refers to the control of video-disc or video-cassette partly by computer and partly by the user. Some video-disc players possess on-board microprocessors, which allows the user to operate all the controls, such as search frame, slow forward, stop frame, play etc., using a keypad. A more sophisticated form of interaction is available for both disc and cassette players by interfacing them to an external microcomputer. The computer program then governs the form of the interaction, and the user communicates via an input device such as a keyboard, a keypad, or a touch screen facility.

There has been a rapid expansion of interest in this medium in the past few years, for two main reasons:

a) it allows designers to introduce more user activity into the already well-established medium of video. It is possible, for example, for the users to be tested on what they have seen, to request a repeat of the previous scene etc.

b) it brings better presentational quality to the well-established method of computer-based learning (CBL) where most microcomputers have poor graphics and no audio. The forms of presentation available to CBL alone are very restricted. The introduction of video overcomes this problem.

The presentation of information and the user's interaction with it are essential components of both education and training. A medium that combines both of these is therefore greeted with some excitement.

Interactive video has been implemented as a pilot study in several educational and training institutions in Europe. The forms of implementation vary according to whether cassette or disc is used, and the form of CBL used. The types of education and training for which it has been developed include a wide range of examples:

i) Video-cassette player plus computer program - the program may provide a relatively unsophisticated form of interaction such as multiple-choice questions. The player shows a video sequence which is followed by a multiple-choice question on the content. If the answer is incorrect, the user is re-routed through the same sequence, or through a remedial sequence. The simplicity of this type of CBL means that it can be built into an authoring system for development by non-programmers. Systems have been developed by Felix Learning Systems, and by Scicon (UK). These have been used, for example, to train oil company personnel in recognising the components of a refinery; to train managers in the elements of interviewing.

ii) Video-cassette player plus computer tutorial - the computer capabilities are better used if a more sophisticated form of CBL is integrated with the video. The Felix System has been used, for example by Ford Motor Company (Europe), to teach statistics. Existing video material illustrates the applications of statistics in car manufacture, and this is intercut with a CBL tutorial which trains the user in the procedures of statistical calculations. A similar principle is adopted by Sonovision (France) to train word processor operators. The video shows a picture of the actual screen, plus animated diagrams to teach the

principles. The computer then simulates the word-processor screen to allow the user to practice the procedures just presented.

iii) Video-disc players with internal microprocessor - some disc players, such as Pioneer and Philips can be programmed from the keypad, or may download program data from the disc into the player's limited memory. This enables the videodisc player to act as a stand-alone video player plus interactive tutorial. An example in the educational field is the Tacoma Narrows disc (University of Nebraska) which uses archive film of the bridge disaster, plus film of model experiments, to teach the physics of oscillations. Multiple-choice questions are presented as frames on the disc, and user input determines which frame or sequence the player moves to next. The limited capacity of the in-board microprocessor means that only the multiple-choice format can be used.

iv) Video-disc player plus computer tutorial - when an external microcomputer is interfaced to a videodisc, the fullest range of video and computer facilities and their combination can be used. A system based on a Philips player has been developed by Computer Assisted Televideo (France), and uses a touch screen device for user input. A system based also on a Philips player, and interfaced to an Apple II mirocomputer has been used by the Open University (UK) for a teaching program on the structure of materials. The overlay facility provided allows fuller integration of the video and computer information. One obvious advantage is that different forms of textural annotation can be generated for the same visual. This has been exploited by Polymedia (Netherlands) in the use of captions and subtitles in different languages, but using the same video.

v) Video-disc plus database management system - a further application of video-disc technology in E&T will be the use of the disc as a resource. Pictorial data can be stored and accessed using some form of indexing system. This may take the form of in-built software devices, such as the disc-based search facilities designed by ISO Communications Inc (US), which does not need an external microcomputer. Other applications will require a more sophisticated database management system. One example is a haematology slide-bank which is accessed via a 'Query'-type program (University of Washington, US).

The sophistication of IV as an educational medium depends on the sophistication of the form of computer-assisted learning (CAL) it embodies. Many applications use only the 'drill and

practice' mode, and restrict the question-answer format to multiple choice. This seriously under-exploits the potential of IV which could make use of all the existing modes of CAL such as simulation, tutorial, Intelligent Computer Assisted Learning, etc. One reason for this is that many developments are carried out by video experts who have no experience of CAL and tend to repeat all the mistakes of early CAL developments. The converse is as bad. When interactive video is developed by computer experts the sophistication of the video is neglected, with equally appalling results.

3.3 The role of computers in E&T

The modes of Computer Based Learning and Training (CBL/CBT) that are most prevalent are 'drill and practice', 'tutorial', 'simulation' and 'modelling'. In their pure forms, they comprise specific kinds of learner activity:

Drill and practice - presents a graded sequence of exercises, giving feedback in the form of correct answers.

Tutorial - presents a teaching sequence followed by a test with feedback in the form of hints on further teaching.

Simulation - provides a menu of options which allows the student to 'operate' a system, specified by a model in the program, and to see the results of his operations.

Modelling - provides an environment (or data) within which the student can develop his own models or descriptions and test their validity in that environment.

The balance of control between program and student is different in each of the above modes. Drill and practice and the tutorial programs offer the student little or no control over either sequencing (the order in which topics are presented) or instructional strategy (when to repeat an exercise, when to refer to remedial teaching, etc.). Simulation and modelling offer the student total control within the limitations of the particular model or environment because these modes do not attempt to teach the student. Instead they provide an environment within which they can learn.

The sophistication of program control can vary greatly from those programs which embody a fixed instructional strategy to those that are 'adaptive'. Adaptive teaching programs keep the debate over the balance of control active. The style of

program that always controls the student's learning is regarded with suspicion - as was programmed learning - because it is inevitably inefficient for the many students for whom the particular instructional strategy chosen is appropriate.

These ideas have all been embodied in practical CBL developments in different ways. Four of the principal current styles of CBL are discussed here none of which correspond to a pure form of the modes described above, but which together illustrate the range of different modes of presentation currently available to CBL.

3.3.1 Styles of Computer-Based E&T

Computer assisted instruction was initiated in the US several years before it was used in the UK. For this reason, the US projets which have survived are now well-established and have had time to refine their various styles of instructional strategy. Each of the four styles discussed below have been implemented in both education and training. Typically, they have originated in the US, but several UK projects have also adopted these ideas and in some cases have developed them further.

a) TICCIT (Time-Shared Interactive Computer-Controlled Information Television)

The TICCIT system embodies a combination of drill and practice, and tutorial styles.(1) The instructional strategy is built into the system and organises the statement of the 'rule', an 'example' of it, and the means to 'practice' it. The practice phase tests the student on the application of a rule to a particular example (it could be: Is this an instance of the concept 'force'?), the student inputs an answer from a special keyboard, and the feedback given may include an explanation or a hint if the answer is wrong. The presentation uses only still frames with words and graphics. The student has maximal control over what is available on the system - they can control the sequence of topics by choosing from a menu of the list of contents of a lesson, they can control instructional strategy by selecting any number of example and practice frames (at chosen levels of easy or hard), and when they move to a testing sequence, they can choose whether or not to accept the advice that they have or have not mastered the topic. Advice is built into the system in two ways. The author can program 'advice' frames that will suggest the student try a harder example, or a more advanced rule. The student is never controlled by the program.

(1) For a fuller description of the project, see Merrill, 1980.

The system is not adaptive, in anything other than a trivial sense, i.e. it monitors performance and offers advice on the basis of this, but does not 'learn' about the student, or adopt an instructional model tailored to the individual. The student has full control, therefore, and Merrill has demonstrated that on this system, students who are given the freedom to decide how many practice and example frames they need to achieve mastery do as well as or better than students without this freedom (Merrill, 1980).

The description of instructional strategy used so far has concerned the selection from available content. What TICCIT does not offer to the students is any choice of how they interact with that content. For example, the student could choose to see a frame showing an example of the concept 'force', but cannot choose to see what happens if you vary the force. Rothkopf has invoked the term 'mathemagenic' to describe activities that 'give birth to learning' (Rothkopf, 1965) - something that all educational materials must attempt to encourage. The limitation of the TICCIT format is they do not encourage some of the most important mathemagenic activities such as hypothesis-testing, 'What would happen if ...', looking for analogies with known concepts or systems etc. This may be a direct result of their decision to serve the existing curricula which, as they discovered limit their objectives to the "concept classification or rule-using level" (Ibid p88). The system is impressive in the degree of student control it allows, but does not encourage the learners to elaborate what they are learning in a way that will make it meaningful and therefore durable.

b) Educational Technology Centre, Irvine

Professor Bork and his team at Irvine, California, have developed a range of teaching materials mainly in basic Maths and Science, which embody both tutorial and simulation styles of CBL. The tutorial style contrasts with that of TICCIT in that, although the students can choose what content to study from a similar menu of choices, they have no control over the instructional strategy, which is built into the program. The tutorials are based around 'quizzes' which are tests in which the learning function is regarded as equally important. The student is given the option of going through a help sequence, which explains the topic, and is then given a quiz which will include help and hints if answers are wrong. The approach to concept learning is importantly different from TICCIT because instead of allowing the student to choose to see examples of a concept, in Bork's

tutorial, the student will be given several program-generated instances and non-instances and asked to identify whether or not each one is an instance of the concept (Bork, 1980). The strategy is called 'concealed multiple choice'.

The approach to procedure learning acknowledges the fact that in order to carry out a procedure successfully, it is necessary to have an understanding of each stage. The method is interactive and is designed to lead the student to discover, for example, a derivation of a theorem. The method inevitably comes closer to being a Socratic dialogue, however, as the computer may ask the student what should be done next, but can only correct wrong suggestions, not follow them through. It is a convergent instructional strategy, therefore.

Simulations are used to give students an intuitive grasp of systems - the relations between objects and concepts, and how cause and effect operates in a system. In the context of theoretical physics, it is possible to create elegant simulations based on a well-defined mathematical model, which can give the student the opportunity to vary a range of parameters and generate a potentially infinite set of behaviours of the system. Seeing the results of successive inputs should allow them to infer an intuitive understanding of how the system operates. For this style of CBL, it is assumed that the system behaves in a rule-governed way which can be understood by becoming familiar with its behaviour. The principle can apply to any system of this type, such as a word-processing system, the planetary system, an electrical circuit etc., which can be modelled in a computer program. Indeed, a survey of CBT in business and industry suggested that simulation is the mode most frequently used (Kearsley et al, 1981). For all these systems, it is perfectly possible for the user to explore them in a totally learner-controlled way, selecting their strategy from a given menu of options, and specifying their own parameter values. Equally it is potentially possible, given this access to the total behaviour of the system, for the user to deduce its underlying model, and by being sufficiently exploratory, to discover all that it can do. It is an attractive idea, but one that is unfamiliar to many people, and the creative possibilities open to the user are often not taken up (Bork, 1978). Bork has attempted to overcome this problem by providing some guidance in the use of such a simulation (Bork, 1980). The strategy adopted is to display examples of what the system can do, and examples of operations the user might carry out in order to explore it. This form of guidance, rather than control, may be advisable in any similar

situation where a student or trainee is attempting to gain familiarity with a system. The point of avoiding program control for this form of objective is that if the user is taken through in a pre-determined sequence the form of cognitive processing encouraged is much more passive. It may also be passive if the user is allowed simply to explore, i.e. to discover 'what will happen if ...', because in this case there is no requirement to connect the result with the input. Mathemagenic activities are more likely to be induced if the user is asked to discover a particular result using the system e.g. how to obtain a particular orbit, or a configuration of the circuit that will yield a particular current etc. (Laurillard, 1981). With set goals of this type there is a necessity for the user to connect the input with the output if a successful result is to be achieved, and it is this form of cognitive processing that is necessary to lead to an understanding of how the system operates, hence it is 'mathemagenic'.

There is no attempt to create an adaptive teaching program in Bork's project. The program uses a standard model to respond to student inputs. The degree of program control is considerable in the tutorial mode, less so in the simulation mode, but the latter requires careful guidance if it is to induce learning.

c) CAISMS (Computer Assisted Study Management Systems)

Computer Managed Instruction (CMI) is a form of CBL that characteristically embodies a high degree of program control over the instructional strategy. It is premised on the fact that students do not typically study in an efficient and systematic way, and therefore builds a theory of instruction into a program that 'manages' what the student does. The presentation of subject matter may not be done by the computer at all; instead the program directs the student to study part of a text-book and then return to the terminal for a computer-marked test. CAISMS at the University of Illinois is an example of this. Alternatively, the system may route the student through CBL tutorial programs.

The eventual aim of this kind of project is to use adaptive or 'generative' programs that will be capable of adapting the tutorial strategy to the individual student's learning characteristics (McConn, 1981). Clearly the extent to which this is possible must depend upon the specifity of learning objectives and performance characteristics. Such a program would require an algorithmic description of classes of problems rather than predetermined exercises and possible answers (McCann, 1981). For example, if the

designer can define the tutorial strategy in terms of specific performance criteria that the program can test, and in terms of specific condition-action rules (such as 'if student has failed on 3 test questions out of 5 then repeat the last teaching operation') then it is feasible for that strategy to be implemented in algorithmic form in a teaching program (see O'Shea, 1979). This kind of approach allows the designer to test for the presence of different models of student behaviour, e.g. the program can be written to deduce from a particular pattern of inputs from a student that they are confusing, say, rational numbers with natural numbers, and on the basis of this can generate further exercises to point out the difference. It is in this sense that these programs are adaptive and can adapt the teaching to individual student characteristics.

The implementation of a tutorial strategy once it is specified is itself a non-trivial programming problem. The specification of the strategy is even more difficult. The designer must have a full description of the possible ways in which a student can make errors, and must have sufficient experience of teaching the subject to be able to design appropriate tuition to deal with those various misunderstandings. This requires a considerable research programme each time a topic is taught this way - itself no bad thing, of course, but undoubtedly a long-term rather than a short term plan.

This sophisticated level of program control will be difficult to achieve. The case for the superior effectiveness of program control over learner control has not been definitively proven; the case for the greater intractability of the former is apparent.

d) The LOGO Laboratory, MIT

The style of CBL that uses the computer as a 'laboratory' is designed to allow the user to practise 'modelling'. The computer program defines an environment, and a series of commands for operating on it. Thus LOGO defines an environment as Euclidean space, and a series of commands that allows the user to operate on an object specifying its position, orientation, and velocity in that space. The expectation is that students will be able to use hypothesis-testing to discover how this environment is governed by a system of laws, in much the same way as a scientist explores the real world (Wildman, 1981). A fundamental principle is "to construct computational environments which embody physics in such a way that students exploring those environments teach themselves the

physics" (di Sessa, 1980, p72). The program exercises no control over the learner, it embodies a complete environment together with all the possible actions in that environment. The student left alone to work on this can work in a pure discovery learning mode, but what precisely does this mean in terms of the mathemagenic activities induced?

The same issue occurs in a different kind of modelling environment, offered by the STATS package at the University of Leeds. This is a simulation language that provides the students with everything they need to explore the operation of statistical methods: sets of data, commands to merge or edit data sets, commands to perform any kind of statistical sampling, or tests, or to display data in vairous forms, or to carry out arithmetical operations. Again the package offers complete freedom to the learner who again must act rather like a scientist, and "formulate and sequence his commands and test the output against his intentions" (Hartley, 1981, p111). The mathemagenic activities induced by such programs ought to be impressive precisely because of this freedom. When the learner is in control, each step of the process is likely to be meaningful to them, and the feedback obtained will tell them whether or not they are closer to their intended goal, and, if not, force them to think about how they might achieve this - this formulation of the learning process has a lot in common with classical formulations of scientific method. There is a problem with this, however. Students and trainees are not typically called upon to act 'like scientists' in an educational context. At home or at play, perhaps, in pursuing a hobby or mending the hi-fi, they may well adapt to the role of 'scientist', but they do not expect it to happen in an educational context. This means that they are not practised at discovery or hypothesis-testing strategies and may not carry them out efficiently. As Howe and Ross point out, the mechanisms to be learnt in order to operate LOGO are themselves formidable, and the student needs help, for example in the form of work-sheets, in using them to make discoveries in mathematics (Howe and Ross, 1981). Similarly, Hartley uses work-sheets to guide students towards the concepts implicit in the STATS simulation package.

Providing a modelling environment for a learner to work in is an attractive educational idea, and it may be that if only it were more familiar to students, they would quickly master this type of learning and be able to do it efficiently. Learner control over the presentation of content is a different problem from that debated over the instructional strategy. At present, the more common

experience seems to be that learners need guidance in the way they confront the content, in both simulation and modelling programs.

What should be clear from this section is that none of the four modes of CBL are typically implemented in their pure form. This combination of styles still does not establish any one preferable style, however, as none of the implementations have overcome all the problems of where control should lie, and of how to induce the full range of mathemagenic activities.

3.3.2 New media - new styles?

The new media that are now becoming available to computer-based learning systems bring a new dimension to the mode of learning they can offer. The advent of media such as teletext and interactive video brings the idea of the database resource into the realm of CBL. This has been limited until recently by the type of information stored on databases, and by the computer storage capacity required. Teletext attracts a wide range of information being displayed in both alphanumeric and graphics format, and video-discs have the capacity to store both still-frame and motion-picture sequences. These media open up the possibility of student access to encyclopaedic quantities of information, made easily accessible by computer control. Teletext offers nothing new in the presentation of information, but the controls of a video-disc player offer a new way of interacting with visual information, such as stop-frame, slow and fast forward, slow reverse, together with the possibility of accompanying audio. These capabilities can considerably enhance the quality of the presentation of content in a CBL system (1) (see for example, Zollman and Fuller, 1982).

(1) The interface between a micro-computer and a video-disc or video-cassette player is technically straightforward, and interface boards with accompanying software can now be bought off-the-shelf.

An example of the state-of-the-art of CBL systems which combine various media is MicroTICCIT. This is a re-implementation of the TICCIT system described earlier, but based on a Data General Microeclipse processor and IBM PC-based work-stations. A MicroTICCIT system can consist of a simple work-station, or many such work-stations linked by a local network (currently 40 maximum, but 150 at a later date).

Optional media, in addition to a colour monitor, which presents video or computer graphics, include

- video-disc or tape,

- random-access digital audio,
- touch-screen or lightpen,
- digitising camera for graphics input,
- 3D panels, breadboards, etc for training.

The cost of a basic 4-station system is currently quoted at £45,000 (including licence for software). Each additional work-station costs £4,500 (Dollar price $52,000 and $4,000 respectively). It thus represents the high-quality, high-cost end of CBL systems, and at present it finds application in training pilots (USAF, Douglas) air-crew (US Navy), operating staff for electricity generating plant, etc. It has also been used by the US Armed Forces for teaching basic job skills, electronics, and part-task training.

PLATO, the 'archetypal CBL system', has also been re-implemented in micro-computer (Z80), multi-media form (as terminals; courseware development still takes place on CDC mainframes). A CDC Viking terminal costs (1983) £3,900, but delivery systems based on IBM PC, Apple, Commodore, BBC Micro and other micros may reduce that cost, and include the ability to control a wide range of media.

The new media have the potential to provide genuinely innovatory forms of learning, but only if sufficient attention is given to the effective design of the interface, in this case the courseware, which is discussed in the next section.

3.3.3 Courseware production

As computer-based learning systems become cheaper, the hardware proliferates and becomes a common accessory to every institution and department. Courseware production has never kept pace with the expansion. A great deal of educational courseware has been produced, but it suffers from two problems: courseware developed for one machine does not easily transfer to a different one; and courseware that is not very well designed does not easily transfer to another institution. The former problem is gradually disappearing as microcomputers and their software packages become more compatible. The second problem shows no signs of improving.

High quality courseware is expensive and difficult. The lessons of the experiments with programmed learning led some projects to conclude that the burden of teaching design was too great, and it is preferable to use computers to direct and manage student learning from conventional materials such as text-books (McConn, 1981). The solution adopted currently by the Microelectronics Education Programme in the UK, is to distribute the responsibility for courseware production as widely as possible, and encourage teachers to develop their own.

This is a relatively inexpensive way of producing a lot of material. An alternative model, adopted by Alfred Bork and his colleagues, is the ad hoc team approach: courseware is designed by a core group of CAL designers and educationalists supplemented by subject matter experts and experienced teachers who are brought in according to the subject matter of the package under development. The design team produces a detailed outline which is then put into production by a graphics designer and a computer programmer. (Bork, 1980.) This model is expensive in designer time and, being centralised rather than distributed, can only produce a limited amount of material at a time.

A fully adequate development procedure for the production of any educational or training materials will include the following steps.

task analysis - making use of existing teaching or training experience to assess typical learner problems, studying the expert performance on the task itself to assess appropriate objectives.

pedagogic design - on the basis of teaching experience and the chosen instructional strategy, design the CBL or CBT implementation.

production - hand over detailed instructions to production team, making use of their expertise to enhance presentation.

evaluation - run pilot tests with a small sample of the population to allow changes before the production is finalised.

These are the minimum requirements for a professional product, and virtually impossible for an individual working alone to carry out. The team approach acknowledges the complexity of the process and provides the opportunity for pedagogic design to be cntributed by a wider range of experience and ideas than one person could provide. The course team model has been successful, for example, in producing high quality educational material in a multi-media form at the Open University. CBL and CBT has rarely been developed in this way, and the more prevalent cottage industry model has not been acknowledged as a success.

Studies of CBT show that instructional gains are higher and time shorter, (States, 1980; Kulik et al, 1980) but differences are small. If CBL and CBT are to become established as efficient methods of learning, then the general standard of courseware has

to be much higher, even if the quantity produced is lower, the quality is intimately linked to the model of courseware production, and the case for experimenting with a different one must now be a strong one.

State-of-the-art authoring systems include ADAPT (for MicroTICCIT), ITAS (Interactive Instructional Authoring System, for the IBM Interactive Presentation System), MICROTEXT (for the BBC Micro, and CP/M-based systems), etc.

These include, apart from in-built course structuring aids, facilities for the exploitation of a range of media and interface devices.

3.4 Cost considerations

Information on the true costs of IT-based learning is sparse. So much so that the British RAF, who undertook a thorough review of the CBT area, was unable to estimate the costs or the timescale of any trial implementation, (RAF Working Party on CBT, 1980).

Costing educational innovations is notoriously difficult, because the cost data that is available is invariably incomplete, (Fielden and Pearson, 1978), Orlansky and String, 1979). Even when it is specially asked for at the outset, as in the British National Development Programme in Computer Assisted Learning (NDPCAL), institutions find it difficult to provide accurate and complete costings, especially on a standard basis that enables comparisons between projects.

3.4.1 Cost components

Our study was no exception. Few respondents were able to cost their IT-based training fully, and the basis on which costs were quoted varied. Some people just had access to equipment costs, others attempted a breakdown of direct costs, few included overheads, salaries or accommodation. In many cases they were clearly no more than 'guesstimates'. Neither was it always clear what the equipment costs referred to. Table 3.1 provides examples of the cost information received.

To the extent that it is possible to generalise at all, where staff costs were given they were usually substantial. In most cases the next major identified cost was equipment, with spending running out at 2 to 5 times that on software, though this varied enormously. Courseware costs tended to be relatively low on average, with maintenance a more significant part of the budget.

It must be added that several people pointed out that software development costs were often underestimated, as are the true costs of personnel needed to develop and maintain CBT. Running costs can also be high; The RAF study found running costs for SPEC and SAFARI worked out at a quarter of total development and equipment costs, a large part of which was personnel needed to maintain equipment, (RAFWP on CBT, 1980).

The multi-media training generally offered by our respondents precludes cost information on particular IT applications. However the following give some idea of the order of magnitude involved. For instance, the capital costs of a banks private viewdata system operating in 110 branches were around half a million pounds, revenue costs (staff + depreciation) were £450,000 p.a., with line charges costing an additional £24,000

Table 3.1. Number of staff trained, cost of training and cost as a percentage of payroll.

Organisation	Number of Employees	Number Trained per annum	% of Staff Trained	Cost per annum	% of Payroll	Unit Cost per Employee
Bank	47,000	13,000[1]	28%	£2.5m	3%	£96
Bank	26,000	2,600	10%	N/K	N/K	N/K
Utility Company	104,000	12,000[2]	12%	£26.1m[3]	3%	£250
Telcommunications	165,000	50,000	30%	90m FR	7%	545 FR
Retail	22,000	17,000	77%	25m DM[3]	N/K	1136 DM
Military Service	90,000	10,000	11%	(10% of total budget)	22%	N/K
Paramedical	10,000	500	5%	N/K	N/K	N/K
Newspaper	512	60	12%	£80,000	N/K	£156
Training Consultancy	1,050	600	57%	£0.5m[4]	3%	£476

1. Procedural training only

2. Off the job only

3. Direct costs only, excluding indirect costs e.g. staff,capital expenditure, maintenance, overheads.

4. Excludes associated costs e.g. travel, accommodation.

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p.a., providing 1650 hours of training p.a. In contrast a university engineering department which had developed 70 2 to 3 hour CAL packages, (largely simulations and modelling exercises) at a cost of £1.5 million, had running costs of £48,000 p.a. providing 6,000 terminal hours p.a.

Information on hardware costs and the rental or purchase price of authoring systems is available but becomes outdated very quickly. It is also a very poor guide to the costs of IT-based training as equipment is not necessarily the major cost. For example, the NDPCAL evaluators were surprised to find that equipment accounted for only 16% of their total budget and that staff costs were 4 times as much, (Fielden and Pearson, 1978). This ratio will obviously vary according to the particular IT application concerned and the circumstances in which it is applied.

3.4.2 Development costs

IT-based training is characterised by high development costs, whereas distance learning has high production costs and face to face teaching has high presentation costs. For instance, the NDPCAL study found that in seven of its higher education projects developments costs accounted for 30-50% of total expenditure, which was 2 to 5 times the annual operating costs and equipment depreciation combined (Fielden and Pearson).

This initial outlay acts as a disincentive for many institutions contemplating the use of CBT. Our respondents were well aware of the high start up costs associated with IT-based training and expected to spend a higher proportion of their budget on equipment and maintenance with the switch to IT training methods. Many people (especially the apparently better informed) also expected to spend a greater proportion of their budget on software and courseware. A few expected the cost of materials to decrease.

These respondents did not seem to realise how expensive software development can be. The annual expenditure on software in the U.S.A. is about five times the sum spent on hardware, (Beohm, 1979). The Computer Assisted Learning Unit at the University of Surrey estimates that it costs £5-10,000 to develop a typical CAL package. Similarly Intra Systems, a training consultancy, argue that CBT is not worth doing unless you have £10,000 to spend on research and development.

Unlike hardware costs, software costs have not declined. They are likely to remain high because good quality CAL and non trivial CBT is very time-consuming to develop. Experienced Open University CAL staff reckon it takes 200 man hours or more to develop one hour of CAL without an authoring system. A

similar figure is presented by Queen Mary College, who suggest it takes 400 man hours to develop a 2-3 hour simulation. The NDPCAL study found considerable variation in development times even in inherently similar packages. Jenkins suggests realistic development ratios for CBT range from 30:1 to 500:1 and in some cases more, though 200:1 seems typical for non trivial CBT. He points out that though some claim 100:1 is the norm, many organisations revise their estimates upwards after genuine production experience, (Jenkins, 1982).

O'Shea (1984) suggests that using an authoring system, the average ratio for CAL is 100:1. The British Telecom Management Centre estimates they take 50 to 100 hours to develop one hour's worth of CBT with an authoring system (Buciak, 1983). NDPCAL also found a project using an authoring system took less time than those that did not (Fielden and Pearson).

CML can require less lines of software than CAL and is therefore cheaper to develop. The software development costs of SPEC the British Army's CML system, were less than a third of their equipment costs (RAFWP on CBT,1980, 2). The Open University runs a CML system on some of its courses at a cost of around £0.70 per assignment per student. This compares to a cost of £7 per tutor-marked-assignment.

3.4.3 Cost Benefits

Very few cost benefit studies of IT-based training have been undertaken. What evidence there is suggests that on cost grounds alone the case for CBT is far from proven, for course populations of less than 1,000.

Few attempts have been made to compare the costs of IT-based training to conventional teaching methods. NDPCAL's attempt to do this concluded that, in 1978, CAL was much more expensive, costing out a £4-15 per student hour compared to £.60 to £5 for conventional methods, (Fielden and Pearson). For example one university CAL package worked out to £5.3 per terminal hour, with a marginal cost of £3.2 per hour. This was costed on a terminal utilisation rate of 20 hours per week and a total provision of 5,500 terminal hours p.a. The equivalent experimental lab costed out at £2.6 per student hour, (excluding development costs). Both were at 1977 prices. On the other hand Queen Mary's Engineering Department CAT Unit, with a provision of 6,000 terminal hours, assessed the cost of providing computer simulations and modelling exercises at £8 (1984 prices), which they claim is within the range of costs of conventional science and engineering labs.

The ratio of capital costs to recurrent expenditure in IT-based learning is much higher than in other forms of training, so

student numbers are a critical factor. In both the examples above, cost effectiveness is limited by the relatively low number of students involved (700 at Queen Mary). The limited terminal utilisation rates of around 550 hours per year, which are in line with NDPCAL's estimates of the maximum usage likely in higher education, are another factor. In contrast, 'embedded training', where spare computer time in an organisation with the relevant hardware is used for training, makes more efficient use of that equipment at negligable costs; British Airways', ticketing system is one such example.

As the marginal costs of IT-based training are low the greater the student numbers the more economic it becomes; with populations of 1,000 CBT compares very favourable with residential training. Jenkins estimated that, in 1982, a conventional course at a training centre with 100 students would cost around £28, including student time and around £16, excluding student time, compared to around £20 and £10 respectively for a CBT course with a population of 1,000. He claims that with 100 students the cost of development, which he assessed at £40 in 1982, is too great. Further, that even the cheapest approach - one author and a microcomputer - is uneconomic with a few tens of students. On the other, hand Intra Systems, a training consultancy, recently claimed that CBT is worth considering if there are at least 100 students requiring a course.

The economics of distance education, a field where cost benefit is relatively well established, offer similar economies of scale. For example, the Open University's relatively expensive multi-media approach, (correspondence, broadcasting, audio, video, CML, CAL and experiment kits together with limited face to face and residential teaching), produces graduates at roughly half the cost of a conventional university. This with an undergraduate population of around 60,000 students per year. Like IT-based training, initial expenditure is high, but marginal costs are low. A correspondence + audio distance teaching service could produce graduates at a fraction of this cost, but with a loss of quality in the service and the impossibility of doing justice to science and technology subjects.

At the present time the OU finds it cheaper to use non-returnable audio-cassettes rather than radio broadcasts for courses with less than a 1,000 students and returnable video-cassettes rather than television broadcasts for courses with less than 300 students. The playback and freeze frame facility offered by cassettes also makes them a superior teaching medium.

With large student populations, a growing body of evidence suggests CBT is cost effective. The main saving is cost

avoidance. A fact well recognised by our respondents who expected the switch from face-to-face to IT-based training to offer considerable savings on accommodation (residential costs and, in some cases, building premises) travel and subsistence costs. British Airways who maintain a network of 3,500 terminals world wide and offer 260 CBT courses through this network, report major savings in this area. One course paid for itself within a year through savings on hotel accommodation and travel alone.

Many of our respondents also expected IT to reduce the course length. One of our respondents, a local authority running an induction course on a BBC micro, found training times reduced from 2 1/2 days to 3 or 4 hours. Such a reduction is rare; however, savings in the area of 30% have been reported. The pharmaceutical company, Smith, Kline and French, found initial training was reduced from 7 weeks to under 5 with CBT. The £20,000 charge by PLATO for their two terminals was largely offset by manpower savings due to course compression. Unlike trainers, educationalists cannot take advantage of these opportunity costs, as any reduction in course time has to be filled with extra instruction; neither can manpower savings be used to offset hardware costs.

The US Navy, which has been using CBT extensively for some years, offers a CML system which is used by 10,000 students at any one time. They claim that by 1977 they achieved a cost avoidance of $10 million dollars or some $200 per student, with a training population of 52,000, due to a reduction in training time. A decrease in average course time is also reported with their AIS system, (CML + a little CAL) and various other courses. These claims for cost effectiveness over traditional methods have been questioned by Orlansky and String (1979), whose conclusions were in turn contested by CBL proponents in the US Navy.

Perhaps the clearest case for the cost benefits of CBL is in part-task training and simulations, used by the military and engineers. These are not cheap, - an RAF part-task trainer can cost £35,000 and a flight simulator anything up to £10 million. Nevertheless, they offer considerable economies because they avoid the need to train on even more expensive prime equipment. The army have also found simulators very effective in training a large number of Chieftain tank drivers: the number of tanks needed for training was reduced, as were running and maintenance costs (Miles, 1975). American Airlines have used PLATO as a part-task trainer to minimise the time needed on an expensive simulator costing some $450 per hour.

An application that is cost effective in one area is not necessarily so successful in another. For instance timetabling

programs aimed at schools and colleges have proved cost effective for this audience, whereas the British RAF decided against the use of CML for resource scheduling because the available educational programs did not transfer well to their needs. Also, they deemed alternative software such as RANGER inadequate and others, such as PLATO, too expensive for this purpose. Other PLATO applications have proved cost effective for them (RAFWP on CBT, 1980).

Of course, cost is not the only factor. IT-based training may well give added value for added cost, a point stressed by some of our educational respondents, reaching people who could not be reached before, perhaps, or doing things that could not be done any other way: flight simulators, for instance, offer pilots the chance to practice landing at a chosen airports, all over the world, in the space of a single afternoon (miles, 1975). A number of trainers also report improved performance: Smith, Kline and French, for example, report better understanding and retention; Barclaycard found procedural errors reduced from 1 in 2 to 1 in 1200 - partly as a result of some improvements to the procedures themselves, that monitoring trainees' performance through CBT had enabled them to recognise (MSC, 1981). These kind of benefits are hard to quantify.

3.5 Reasons for using IT in education and training

In what ways, then, can IT help in coping with the challenges facing E&T?

We have found a good deal of support for the notion that the use of IT-based systems can:

- improve the effectiveness of education and training;
- lead to more efficient utilization of resources e.g. cash, manpower etc. and have considerable cost benefits.

The keyword, perhaps, is 'flexibility' - flexibility of access, of methods and approach to the learning process, of type, content and delivery medium of learning materials.

One recent survey on the use of IT-based systems in E&T (carried out by a consultancy company in the UK) referred to the problem of gathering a sufficient basis of data from which to draw hard quantitative evidence in support of the 'accepted pluses'. However, virtually all of the practitioners they spoke to were of the opinion that the use of such systems could be highly motivational, can offer course compression, allow effective distributed education and training with resultant cost savings, and generally lead to improved performance by trainees.

Drawing particularly on comments from our respondents, we can examine here these 'accepted pluses' in more detail.

3.5.1 The Quality of E&T

To begin with we can look at the effects that the use of IT-based systems can have on the quality of learning itself.

IT, it was felt, provides a flexible and open-ended learning path, allowing very rapid assimilation of new knowledge and skills. Among those factors identified as unique to IT, or best provided by IT, were:

- rapid interaction giving the learner the ability to try ideas and see a quick result;
- access to large and speedily updated database;
- the facility to make learning personalised and responsive to special abilities or weaknesses;
- the ability to enhance learning and make it more enjoyable by use of sound and graphics.

One respondent identified three broad characteristics to good IT learning materials:

- interactivity;
- immediacy;
- individualisation.

The interactive facility is held by many to be a key factor in enabling people to learn better, faster and in a more enjoyable way. The learner is able to take decisions about the course of his training, to receive feedback on his answers and, if necessary, to be routed to remedial units for further study. The use of IT offers the possibility of student-centred discovery learning with the student assuming some responsibility for, and exercising control over, his own learning progress.

Students are able to input responses to psychometric tests directly, receive immediate results on-line and an assessment of relative performance e.g. to other or previous course members. The removal of the time-lapse between, say, a trainee completing an exercise and receiving feedback on his performance is seen as significantly increasing student motivation.

The provision of individualised learning is considered of great value, where the student can proceed at his own rate and in his own time. The content of what is taught can be altered to match an individual's level of attainment; the time - and the place - at which training takes place can be more flexible; the pace of learning can accomodate individual requirements. Individualised instruction is of particular benefit to slower trainees, who receive more remedial instruction, and to mature students who can make mistakes in relative privacy and are not subject to the inhibitions which might make them reluctant to interrupt a lecture etc.

Throughout our study the opportunities for individualised learning for self-study which are offered by IT systems are highlighted. One response, by an industrial training consultant in the UK, is worth quoting at length:

"IT-based training is typically self-study, the IT replacing the trainer who is becoming relatively expensive. Several advantages of self-study are well known and widely quoted e.g. the ability to progress at the individual's pace, available at times and places to suit the individual, consistency of material/content from implementation to implementation. However, traditional self-study training also suffered from several disadvantages - no moving pictures, no trainer control over progress, inability to explain misunderstood points in another way etc. - and it is in the elimination/reduction of some of these that IT can assist.

Thus text is replaced by videotape, videotape by computer-controlled video disc; programmed-instruction text is replaced by CBT and CBT in turn enhanced by being video-integrated.

Telecommunications developments and local intelligent terminals or PC's facilitate central storage of courseware, its updating and down-loading to the trainee, followed later by retrieval of results for centralised progress monitoring and record-keeping - all these factors influence the use of IT in E&T."

Self-paced adaptive training is felt to lead to considerably reduced course length. A reduction in training time of 30% on more traditional methods of instruction is seen as realistic - and is, in fact, regarded by some as a conservative estimate.

There is also some evidence that the retention of information delivered through IT-based systems is higher than by conventional methods. For example, one UK local government authority evaluating a particular training programme which they were delivering by CBT found that three or four hours use of these programs on disk gave the same sort of retention level as a two and a half day conventional course.

3.5.2 The de-centralization of E&T

What is widely regarded as one of the most significant advantages of the use of IT-based systems in E&T is the flexibility it affords as to where training actually takes place. The move towards decentralisation of the E&T provision - as one source put it, wherever there is a terminal there is a potential training centre - and the use and development of distance learning systems are seen as having enormous potential.

It was felt that diminishing resources make the development of distance learning philosophies essential. The use of distance learning systems reduces the disruption to the organisation, and to the life of the trainee, by reducing the number or duration of residential courses. It permits training to take place at several different locations (and if necessary in different languages) without necessitating the transfer of personnel. Some training prospects are limited because of difficulties in gathering trainees together for conventional courses; this is an obstacle which can be overcome. Equally, training can be carried out where it might not otherwise have been possible such as on board ship.

The opportunity to learn either on-site or in the home is seen as particulary advantageous and of especial value to adults. There are often many barriers to those who want to enter, return to or continue E&T, whether of a geographical nature e.g. travel problems, no local course available, or personal e.g domestic

ties, personal disability. Expanding and cheapening the networks, it is felt, will provide a particular service for the unemployed, the disabled, people kept at home by children or other dependants, and those in remote areas.

The use of IT in all its forms is just as applicable to slow learners, physically handicapped, those in need of post-accident rehabilitation, with impaired vision or hearing etc. as anyone else, but there is an especially wide range of applications of microelectronics to the needs of people with communication difficulties e.g. voice input for the articulate with poor limb functions, braille terminals for the blind, portable terminals allowing the deaf to use the public telephone system etc. The use of IT by the handicapped for E&T can help in two ways: by improving the chances of communication; by enriching the range of curriculum activities accessible through the new communication aids.

Ultimately, it was felt by our respondents, only with the use of distance learning systems will it be possible to cope with the demand for, the volume and range of E&T now needed, especially for adults.

3.5.3 The Management of E&T

Increasingly IT is playing a valuable role in the management of E&T and is seen to lead to a far more efficient management of the training process. It increases the effectiveness of the administration of a course or training department, thereby reducing the administrative pressures on staff and enabling them to monitor the students' progress more efficiently.

Tasks such as timetabling and student registration, compiling and marking tests, recording students' progress and performance, providing comparisons between individuals and groups of students, validating course material and tests - all of these can be successfully carried out with IT systems, relieving the trainer of a great deal of time-consuming routine work and enabling him to make more effective use of his time. In the words of one educational institution, which is making increasing use of IT for internal record keeping, stock control, students' data and word processing, the applications are legion and have all saved time, effort and waste.

The use of IT facilities can help provide management with up-to-date information on such areas as the rate of trainee throughput, the elements of a course in which trainees are doing well or poorly and the requirements of individual trainees. In general, IT can provide for comprehensive monitoring, more sophisticated and more flexible testing and evaluation in E&T.

One feature which is widely referred to is the scope for consistency and standardisation of training materials which the use of IT offers. With no 'off days'- unlike certain instructors perhaps - the quality, quantity and content of the material presented doesn't vary. Equally, as well as making training available to those who may not previously have been able to attend a standard training course, IT can help to ensure that training in a particular topic can be standardised. In industry, for example, with the decentralisation of many functions, including training, to branches, factories, area offices etc., IT can be used to provide a local standarised input of anything from operator training in power stations to sales training in shops.On-site training packages providing, say, technical information and data can be produced in one training centre, encouraging a national training standard without demanding personnel mobility.

Another area where the use of IT is seen as having considerable benefits is in the ease with which material can be amended. One of the values, of CBT especially, is as an information source providing immediate access to quantities of stored facts and figures which can be readily updated.

3.5.4 The Allocation of Resources

The use of IT in E&T may not result in less expenditure but taking other factors into account it may nevertheless compare favourably with traditional methods. A detailed analysis of costs etc. was contained in Section 3.4. But here we can briefly examine the implications for better allocation of all resources.

IT is seen as improving training efficiency and, thus, reducing unit costs of training, where efficiency is measured in terms of reduced manpower required in training, reduced costs of equipment to be used in training (e.g.simulators replacing prime equipment) and reduced time trainees need to be in training.

Certainly, the cost factor is a major stumbling block but it is felt that, for example, the sometimes high costs of developing and testing course material can be recovered in a reasonably short time, depending of course on the scale of activities. While the development of courseware in-house can be expensive, once developed the duplication costs of courseware are minimal.

Other areas where savings can be made are on the often high costs of off-the-job residential courses and the incidental expenses of travel and accomodation, on centralised instruction staff and centralised training premises. Delivery on-site obviously cuts down on time spent travelling, another factor in reducing overall training time and hence the opportunity costs of cutting

excessive employee downtime. Even with residential courses, IT systems offer good opportunities for material to be distributed off-site allowing course members to do some pre-session work so that they are familiar with concepts, terminology etc. and some post-session reinforcement, all of which can cut down on the time spent with resultant cost savings. As indicated earlier, this reduces tedious routine parts of the tutor's role enabling him to spend more time on providing remedial or specialist tuition.

The opportunity for pre-session preparation is of value in the sort of situation faced by the military, say, with the problem of providing a training programme for a large number of pupils at any one time with a wide variety of backgrounds, by reducing class time spent in bringing all recruits up to the same starting level.

On a slightly different tack, some respondents have found that as the number of training needs increases with a faster pace of change, the number of trainees requiring a particular course at a particular time has fallen, thereby reducing the cost-effectiveness of the traditional approach. The use of IT can present a means of overcoming this as well as the problem of staggered recruitment times: the situation is eased by having ready access to learning at times convenient to the trainees and to the company.

With regard to equipment, the use of IT in E&T is a way of making fuller use often of existing resources installed for operational purposes, whether an internal viewdata network or existing computer facilities - many organisations have excess capacity on their in-house systems which may be used for training applications.

The increasing use of computer based simulations can represent a better allocation of equipment resources, especially in training for high cost, high risk pieces of machinery such as airliners or tanks: to fly an aircraft simulator for one hour costs one tenth of the price of flying a real aircraft - without the danger of crashing; chemical plant training represents another area where the costs of error are very high and the real plant cannot anyway be used without expensive shutdown.

As one respondent said, there are things that can be done using IT-based systems that would be too dangerous, difficult or time-consuming by any other means - and IT systems can broaden the perspective of training considerably without usurping the role of the trainer or instructor.

3.6 The education and training sector

The 'formal' E&T market sector comprises all institutions of education and training (schools, colleges, universities), all commercial training companies, as well as all training sections of non-E&T organisations and companies.

The size of this market is difficult to assess, particularly in relation to training activites. Our assessment is that it involves about 100 million people in the Member Countries (60 million in education and about 40 million in industry and the military), and takes up about 6.5% (5.5% for Government spending and 1% for private expenditure on training) of its GNP. In absolute terms (1978 figures) this amounts to about 100,000 million ECU.

To this one needs to add the 'informal' E&T sector, that is the market for products with an educational/training content, which has not been supplied by the formal E&T sector. This includes publications (books, magazines, tapes, etc) for 'self-improvement', personal computers and software marketed with an educational emphasis, etc.

An important attribute of this sector is that it is increasing, at least in terms of the number of its 'customers and clients'. In purely financial terms, the 'formal' part of the sector cannot be expected to increase, indeed it may even contract, due to increasing demands in many other spheres of expenditure of national governments and companies. The 'informal' sector, however, is likely to increase in both volume and financial outlay.

IT manufacturers and service providers can capture a larger share of the E&T market than hitherto if they can demonstrate the cost-effectiveness of their products and services. This applies, in particular, to fulfilling the potential of coping with the extra demand for E&T at no significant increase in cost, and to demonstrating conclusively the advantages for IT listed in Section 3.5.

Even so, some words of caution are necessary:

1) the formal E&T market is currently fragmented and non-uniform in its needs and requirements;

2) it is notoriously conservative in its outlook;

3) it is inexperienced in IT matters, as our review of the educational uses of IT has just shown.

What are the future needs of this sector? We summarize here the responses given to us by our contacts.

3.6.1 Future Expectations

Generally, most of our respondents see a steady increase in the use of IT-based systems in E&T, especially in the application of microcomputers interacting with telecommunications, particularly where directed towards information transfer. There will be a greater use of more sophisticated automated production systems, for widespread application of IT to business systems, for an increase in the rate and volume of information transfer etc. It seems likely that the whole area of E&T will be subject to a wider application of IT to satisfy these requirements for improved business controls, machine control, CAD, information transfer etc. In the words of one respondent, it is unlikely that in the future people can be untouched by the applications of IT and if Europe is to maintain its present fairly advanced position in terms of computer technology particularly, these moves are essential.

There is almost universal expectation of an 'information explosion', with a huge expansion of networks for largely micro-based data-exchange systems, with access available more widely than at present and more cheaply. Connected to central data banks and to each other, these systems are expected to greatly increase the speed and flow of information whether, in the E&T field, between researchers, between authors and publishers, between teachers and distant learners.

IT-based systems will make more information available to learners and enable them to process information more effectively. A substantial increase is anticipated in the range of on-line facilities for finding and retrieving specific information on a personal need e.g. legal matters, tax, consumer affairs etc., plus plenty of adult 'self-improvement' material as part of the provision for the anticipated growth in home learning. Currently ranging from the home-computer oriented Prestel, in the UK, or Micronet 800 to Dialog, say, and the big commercial data-bases, it is felt that more and more of these systems for the dissemination and retrieval of information are likely to come on-line.

This is a part of what is seen as the widespread development of open learning systems to facilitate distance learning and open the access to different E&T options. The use of distance learning systems is seen as having enormous potential, especially in the flexiblity it affords for learning to take place at home. The ability to transmit courseware over long distances, whether through computer networks, cable and satellite transmissions etc. is certainly an important consideration in the widely-anticipated shift of emphasis in the E&T provision from schools and colleges, training centres etc. to the home. One respondent envisages, as part of the wider 'information revolution', almost total

decentralisation and deformalisation of learning from E&T institutions to 'community resource centres' staffed by learning consultants organising and managing computer-based courses transmitted by cable networks directly into the home and a "new generation of learners who will face their tutors over VDUs and have access to international networks of databanks".

With the technological developments, it is felt, will come a change in attitude on the part of learners/trainees - a shift away from the deep-rooted 'safe' classroom model as the notion of individual, self-study training becomes more acceptable. An important pre-condition for this, however, is that the technology should not be intrusive in the learning process. On the contrary, it should be a helpful, intelligent and always available aid.

4. OPPORTUNITIES FOR ADVANCED EDUCATIONAL TECHNOLOGY

4.1 The next stage in educational technology

It will be clear from our review of the current state-of-the-art in educational technology that there is no super medium which will replace all previous media in education and training. Education and training therefore will become more and more multi-media. This has two major implications:

- the choice of appropriate media becomes more crucial more complex, and more context-specific;
- the organisation of multi-media teaching and training becomes equally crucial, more complex and more context-specific.

When considering choice of media, the following factors all need to be taken into consideration:

1) Type of course: e.g. up-dating; new skills; basic education; etc;
2) Training objectives: manual skills; inter-personal skills; awareness raising; etc;
3) Costs;
4) Access to equipment by users/location of learner (home, work, training centre);
5) Available production/distribution facilities;
6) Ease of production/trainer time;
7) Institutional boundaries/complexity of organisational and operational issues;
8) Availability of trainees (groups; time; individually);
9) Speed of response required (how quickly/how many).

With regard to organisation, new technology more and more demands a team approach from subject experts, technology-based producers/designers, and instructional designers. This increases the complexity of design and organisation and also increases the time it takes to design training materials. This also leads to several approaches to organisational issues:

1) Single-media learning

Learning is based on a single medium (e.g. text or video), at least for a whole section of the curriculum, (this is still the most prevalent). This has the advantage of simplicity for the trainer, who can concentrate on the medium with which he or she feels most familiar. This is not necessarily the most effective way of meeting specific training needs, and certainly may not suit the learners.

2) Autonomous, centralised teaching/training systems

Here the training system is designed around the technology, and is controlled centrally. The training is multi-media, with teams designing the material made up from a range of specialists employed in-house. This system allows the full range of media to be expoited, and enables many different levels of training to be provided, especially for large numbers of trainees. The Open University is an example in the public sector; similar examples can sometimes be found in the military services and large multi-nationals. Some of the large computer companies, such as Digital, are also producing multi-media in-house training systems (e.g. IVIS). However, such a system requires heavy initial capital investment, has high fixed costs, and responds slowly to new training needs.

3) Bought-in training

A small in-house training unit buys-in or commissions training materials and the accompanying technology from professional training 'production' companies. This is becoming more and more common. Such production companies still tend to be single media, but more and more are producing training materials using a range of media, such as video, computer-based training, and teleconferencing. This form of training can enable a company to respond quickly to new training needs, provided that suitable materials are already available 'off the shelf' or can be quickly amended or produced by the professional training company. Often however, materials have to be designed from scratch, and such provision cannot be used where internal company security is essential.

4) Centralised technology and local training

In such a system, decisions are made about the basic infrastructure of technological provision (often for operational or marketing reasons rather than training reasons) and local training initiatives take advantage of the existing infrasturcture. Thus for instance a company

may have a local-area network of microcomputers for stock control, and NCR machines available at different branches or plants, for point-of-sale marketing. Local trainers can then produce or commission training materials which exploit the existing technology, buying in expertise or materials as appropriate.

5) Co-operative systems

Because of the high cost of creating and designing multi-media teaching materials, several organisations may get together to pool resources to create training materials which will be commonly used. There have been several such initiatives. In Britain, Open Tech projects to provide open learning systems at a technical level are often designed by consortia of local colleges in conjunction with industry. In British Columbia, Canada, Knowledge Network, universities, professional associations and local community colleges have come together in a number of fields. This way costs are shared, different media are exploited, and the learner gets an integrated teaching package.

What is clear from these various organisational arrangements is the growing importance of teaching a system approach to training, to ensure that appropriate media are chosen and the training organised so that it is flexible yet meets learners' needs. This in turn, however, places tremendous demands on trainers. It is clear that if information technology is to be more fully exploited in education and training, a number of developments are necessary:

1) Clear understanding of the differences between media in meeting different training needs.

2) Better understanding of the organisational requirements for different training needs.

3) Better training for trainers.

4.2 Expenditure

Vocational training accounted for some 16% of total government expenditure of education and training, but as shown in table 3.2 this varied markedly between countries from over 20% in France, Ireland and the Netherlands to under 10% in the UK, Belgium and Italy.

Since 1978 there have been a series of major initiatives in the Member States in the field of education and training. The impetus for these new developments has come from two main areas. First, there is the need to meet the training requirements of IT.

For example, the French and UK Government schemes to equip all schools with microcomputers. Second, the desire to respond to the problem of youth unemployment. In 1982 the EEC Social Fund alone alloted 457.2 million ECU for vocational training and retraining for half a million young people.

Private expenditure on training is also substantial. For example in the UK, the Manpower Services Commission (MSC) estimates employers spend £2,500 million annually on training compared to the £4,000 million the government spends on further, higher and adult education (Times Higher Education Supplement, 3.2.84).

The total training costs in Germany were estimated at 9 millionDM in 1972, then 1.1% of GNP. In the same year industry was paying out an average of about 100 DM per employee on training (CEDEFOP, 1980).

Where figures were available, our survey also suggests that training represents a significant portion of a company's budget. Table 3.1 showed that the actual sums spent on training were large, for example £26 million on direct costs only for the UK utility company with 100,000 employees, i.e. £250 p.a. per employee, 3% of its payroll; but this is very variable thus the telecommunications company spent approximately £50 per employee, 7% of its payroll. Where a figure was given, the percentage of salaries spent on training ranged from 3-7%, except for the military service were the equivalent figure was 22%, which corresponded to 10% of their total budget. The amount spent on training per employee where this can be calculated, ranged from £50 to £300, with the exception of the training consultancy where the figure was nearer £500. Other data supports this range of cost, for example a bank budgeting £375 for training computer staff this year, and a buildings materials firm badly hit by the recession still managed to spend £272 on its computer staff in 1983, albeit at the expense of management training. (Computing, 9.2.84) Of course such high levels of expenditure are unlikely to apply in all industries.

Global predictions of the need for increased training in the future imply that with conventional E&T, expenditure on training will have to increase from current levels. For example Britain's Manpower Services Commission (MSC) claims 1/2 to 2/3 of the workforce will need retraining in the next 5 years. Further the use of IT technologies has tended to increase the professional and technical staff needed, who take the longest and are most expensive to train. For example the shift in the semiconductor industry from electro-mechanical to large scale integrated circuits has already resulted in a requirement for highly skilled engineers and technicians to make up 30% of the workforce as opposed to the 5%. In addition most EEC countries

report a shortfall of computer programmers, analysts and electronic engineers. For instance, the Olivetti survey of companies producing mechanical and electronic information products showed a similar shift from precision engineering towards systems analysis and computer related skills (Gordon and Pearson, 1984). This trend is likely to increase in future years. For example, the Warwick Institute of Employment Studies predicts a 30% reduction in low level positions only requiring low level industrial skill along with a 25% increase in management and administrative positions, and a 35% rise in higher level industrial and professional service skills.

In view of these structural changes in the employment market it is perhaps not surprising that the majority of our respondents, especially those in the private sector, expected the amount of money they spent on education and training to increase in real terms in the next 5-10 years. Some expected expenditure to stay the same. A few others expected expenditure to decrease due to falling manpower levels.

4.2.1 Future trends

Most of the organisations we contacted expected to increase their use of IT-based training and distance learning in future years, as an anticipated fall in the costs of associated hardware comes about. In some cases, informants stated IT-based training would have to stay within the total training budget or a small increase of the same.

The next 5-10 years is likely to see a considerable increase in the number of CBT users, largely because the declining costs of computer hardware have made the cheaper mini computer and the low cost microcomputer available to a wider group of potential users. For instance, the first microcomputer cost around £1,000-£1,500 in 1975, now machines with full colour graphics etc. can be purchased for a few hundred pounds. At the same time the reliability and sophistication of these machines relative to cost has increased exponentionally. Projecting into the future on the basis of past performance, O'Shea and Self (1983) suggest that a micro with 1 million bytes of main memory could cost as little £500 in 1992. This would be capable of running most training programs.

Despite the fact that the cost of the mainframe processors, main memory and discs has decreased at a similar rate, they are still very expensive. For large organisations who maintain a network of many hundreds of terminals, mainframes may contain their cost advantages; mainframe discs are still as much as 50 times cheaper than floppy discs.

However, it is the mini computer and more especially the micro based CBT that is likely to increase in future years. Falling prices have brought the mini computer within the reach of many training and education departments. They offer lower running costs than mainframes, because they do not require a controlled environment and can be operated by non-computer specialists after minimal training.

4.3 Scenario for information technology relevant to education and training in the 1990s

4.3.1 Introduction

In this section we shall provide our view of the IT products and services likely to be available over the 15 years 1985-2000. We should stress that although we have naturally brought our own judgement to bear, many of our conclusions are based on documentary work well known to the Commission - e.g. A.D. Little (1983). In the interests of conciseness, we have tended to concentrate on those products and services likely to be of interest to the E&T industry - thus for example we spend little time on discussing the likely price/performance of supercomputers.

We have avoided using the scenarios of futurists such as Toffler as anything other than background, since such scenarios are usually devoid of timescales, market sizes, and (some would say) clear socio-economic mechanisms for getting from here to there.

On the other hand, it is equally dangerous to fall into the trap of quoting market sizes or penetration levels without any consideration of how these apply to the socio-economic groups likely to be consumers of E&T; for example in the UK the uptake of VCRs and home computers is higher in the C1 C2 (so-called "working class") socio-economic groups.

Some distance educators appear to believe that very high penetration levels of even elementary IT equipment (such as the telephone) are necessary before it can be "used in education". Our view is that such opinions reflect the traditional lack of cost-justification prevalent in the "education" end of the E&T industry. What is more important in our view is the combination of:

- potential availability of the product or service
- cost of taking up the product or service.

In this sense, the telephone is 100% available to EEC customers, at a cost which depends on the particular country - see Mitchell(1983) for rates in several countries. Likewise, educators in the UK may say that videotex is expensive, but it is

100% available. Compare these examples with cable TV: if one equates availability with "homes passed", then estimates of availability in 1990 are in the range 16-27% . Thus any E&T system using cable TV as a subsystem has to accept a limited market or develop alternative subsystems (e.g. postage of video cassettes) to reach the other consumers. We shall not apologise for belabouring this simple point, as it is often forgotten.

The example of cable TV points up very well that there may be wide regional dispartiies in availability as well as the more usual differences between professions, socio-economic classes, and business versus residential users.

The next three sections will cover our predictions for

- computers and peripherals
- audio/video
- telecommunications.

4.3.2 Computing

Hardware:

On reasonably conservative estimates, the price of semiconductor memory and logic is falling by one order of magnitude every 10 years, and the logic speed increasing by one order of magnitude every 10 years - see A.D. Little (1983). However, the price of other equipment needed for a personal computer is not falling nearly so fast. Currently both printed output and bulk data storage require electromechanical devices, and the display requires a television tube, and price reductions of these per annum are more at the 10% level. On an optimistic note, the existence of a mass market and energetic manufacturers can provide substantial cost-reduction, for example in even such a recalcitrant blend of technologies as found in the video-cassette recorder.

It may be worth considering the trend of price for a machine of the sort envisaged for students by the UK Computer Board(5). This would have a processor comparable with the Motorola 68000, 1 megabyte of main memory, reasonable quality colour display, and twin disc drives. One could expect this to decline from about £3000 currently to £300 over a 15-year period, probably gaining somewhat in performance over the years.

One may argue with this, and it certainly is a conventional prediction, not assuming any near-term dramatic breakthrough in flat-panel displays or bulk semiconductor memory at the 10-megabyte level. However, the last few years of alleged imminent breakthroughs in these areas may make the cautious approach the right one.

Oddly enough, there are likely to be far greater increases in price/performance in the larger machines, due to advances in large-capacity magnetic and optical storage, and the production of printed output by laser methods.

Software:

We expect the trend toward portable languages and operating systems to continue. We do not expect any newer sequential third-generation languages than ADA to develop and gain wide acceptance in the marketplace; and the likely penetration even of ADA into the commercial market is highly uncertain. It is suprising to see how well the traditional languages (COBOL, FORTRAN, BASIC and more recently C and PASCAL) have held up under the onslaught of new ideas.

Although advocates of the "software factory" approach may argue otherwise, we do not believe that average programmer productivity in the traditional languages will rise by more than a factor of two: the beneficial effects of the Factory approach, increased standardisation of languages, and longer learning periods for students (e.g. from school onwards) being pulled back somewhat by the effects of more complex interfacing problems to a wide range of peripherals. Order of magnitude advances in productivity will have to come from so-called "fourth generation" languages in the tradition of RPG, MAPPER and the like, but there is a real danger that a major move to such languages (which has yet, suprisingly perhaps, to take place) will be overtaken by the progress of non-sequential 'logic languages' more appropriate to fifth generation systems. There will have to be a major retraining effort to orient programmers towards logic languages and it is likely that many staff will find it difficult to merge the traditional (sequential) languages with the fifth generation (non-sequential) ones in the way that will be necessary for solving real-world problems. Indeed, some of the difficulties in the way of fourth generation languages (including author languages) have probably come from the difficulty of blending them with the traditional sequential approach.

The current favourite operating systems such as Unix (and Pick in the commercial world) do not handle concurrency at all well, and yet the typical networked single-user workstation will be running multiple processes (print spooler, window managers, communications handler, etc). We can hope that these systems will be enchanced to cope in the way that is already happening with procedural extensions to cope with database and graphics (GKS) - however, a long period of ad-hocery can be expected. The ideal solution to some would be to pull down some of the better mainframe operating systems onto the next generation of micros, and it will be interesting to watch, for example, IBM and DEC develop their existing starts in this area.

Network support will also be necessay for languages, and this will come last in the long process of OSI standardisation: we would not expect working standards (in the sense of routines appearing in production COBOL and C compilers) for at least another five years. In the interim the lack of these will be another negative factor on productivity.

Peripherals

Keyboards:

Predictions about the impending obsolescence of keyboards are often made and as quickly forgotten: we expect the keyboard to remain the dominant input medium for at least the next ten years. After that, social factors may play as large a factor as technical ones, and keyboard familiarity may seem as 'traditional' as writing, or it may die away. Either way, there is no excuse not to train all the current generation of EEC school children in keyboard skills.

Keyboards are now a mature technology. Possibly the last step is currently just appearing, that of having a dynamic display of soft key legends just above the soft keys.

Display:

Most people expect the replacement of the cathode ray tube by a flat panel display sometime in the next 15 years, but there is no consensus as to when. Based on current trends it is likely that one shall see flat panel displays of similar functionality to CRTs (i.e. capable of displaying reasonable amounts of text and graphics) first appearing in devices where the additional cost or degraded functionality can be accepted, e.g. portable terminals.

There is no consensus as yet to the appropriate size and capabilities of the display on personal workstations. There is real industrial inertia behind landscape A4 medium-resolution monochrome displays, and landscape A4 low-resolution colour displays (based on CRTs similar to those for domestic colour TV). Ergonomic pressures will force an increase in colour image quality, and workstations oriented to word-processing may eventually offer portrait A4 high-resolution displays as standard. The landscape A4 medium-resolution monochrome display (capable of displaying about 24 lines of 80 characters and/or 480 by 640 pixels) is likely to remain the stalwart of the the general-purpose personal workstation for the next ten years (which probably takes us into the flat panel substitution era).

The physical size of display is another factor still much in dispute. If the "Displayphone" concept takes off (piloted by Northern Telecom and Pye among others) where the display is a

small monochrome one built adjacent to the handset, this may become the dominant type in market share (everyone in business has a phone). We suspect that serious display users will also have a larger display and keyboard adjacent to their desks, the Displayphone being used for telephone directory enquiries, diary and mail management, and casual videotex database searches.

The E&T market is most interested for its needs in a landscape A4 medium-resolution colour display capable of being driven from a computer text/graphics and video source simultaneously. The most likely standard for controlling the display will come from level 4 teletext (alpha-mosaic plus alpha-geometric, including video background options).

Graphics input:

A modern computer display can produce text and graphics output, but whereas text input comes most naturally from a keyboard, graphics input comes from a variety of pointing devices. The industry offers joysticks, touch-sensitive screens, light pens, digitising pads using pens, and the so-called "mouse", all with their advantages and disadvantages, all undergoing systematic cost-reduction.

For low-resolution entry of coordinates (e.g. for choosing one out of a dozen or so options), most of the current devices are over-engineered, and there may be a market niche for a device which could interpret finger pointing (without touching or even getting near to screen). On the other hand, keypads serve fairly well, and the particularly keyboard-shy may be better served by voice input devices.

Voice output:

Voice output boards are now becoming available at prices of £100 - £200 for attachment to the popular microcomputers, and the technique is being built into systems in such areas as telephone exchanges - see Willis (1982). We can expect to see voice output systems develop rapidly in price-performance over the next few years, and attachments for micros producing natural utterances becoming available at around £50.

Pressures leading to cheap voice output include (not necessarily in decreasing order of importance):

- toys and games
- voice response for digital exchanges
- largely US-inspired development of voice information services responding to touch-tone phones
- aids for the blind.

There are no specifically educational pressures of any significance. However, voice output will be a useful tool for conventional computer systems design, as it will alleviate the cluttered and multiple screen syndromes now proliferating in sophisticated control applications. It may even considerably simplify the interfaces for screen editing and program development systems, and have a knock-on effect in the CAL authoring area.

Voice output routines will have to be available to the averagely competent applications programmer (including CAL authors). They are likely to be based (like several current systems) on decoding algorithms applied to character strings of letters.

However, this is not the end of the story: there are sufficiently many variant utterances of most sentences that phrasing, tone and other features will have to be added. (This will be much cheaper than building an AI system to provide full context semantics for the utterances!) The situation is analogous to providing attributes for text: one can get reasonable results by adding a few features (cf. underling and emboldening); one does not always have to go as far as a phototypesetter would.

Considerable progress will also be made in the next few years on 'unintelligent' digitising of speech (i.e. digitising the sound but not the sense; compare facismile with OCR). Although the CCITT have standardised on PCM sampling giving a 64 kbps digitisation, other organisations (e.g. equipment suppliers providing for large corporations and private value added networks) will bring out systems for 32 kbps of 16 kbps, or even less if cost pressures bite. However, much of the effort to achieve lower bit rates may come from organisations producing equipment for voice store-and-forward systems ('voice mail').

When systems designers can have voice output as easily as they can have graphics output, a number of highly interactive training applications become possible, which were not previously possible even on video disc. One problem with video disc is that even with its 200,000 stored frames, it can still be overwhelmed by the combinatorial complexity of a moderately complicated CAL dialogue. With computer graphics plus voice we can escape from the limitations of pre-stored pictures, even if we use some pre-stored pictures as a backdrop to paint our graphics on (as in the latest generation of video games).

The E&T market wants voice output, regarding it as particularly user-friendly. It also is seen as bridging the gap between silent computer-assisted learning and talking video disc, and also as a way of putting sound on still video disc frames.

Voice output services ("audiotext") are also likely to be popular with domestic telephone users who will not find a screen appropriate for their home environment. However, we expect business users to prefer the Displayphone concept.

Voice input:

There are two distinct types of input device to consider here. The first is the type which recognises a small number of isolated words. These are now becoming available for commercial use. The question is whether their use will be restricted to specialised areas, on grounds either of expense or of user preference.

For example, it certainly would soon be possible and even cost-effective for PTTs to provide a voice-activated telephone system where one just needed to lift the handset and speak the dialling code to get connected to the called party. On the other hand, keypad telephones may by that time be a cultural fixed point. After all, the rotary dial telephone is not easy for children to use, but most of them get to grips with it very early in life (too early for most parent's financial peace of mind!).

On balance, we believe that voice input devices of the first type will be restricted to specialised applications of the "no-hands-or-eyes-free" type, e.g. car telephones. We regard voice-input text-output devices as of marginal significance except to academic ergonomists.

The second type of voice input device is the kind that will recognise natural speech. This is one of the goals of the Japanese Fifth Generation project. We believe that the goal will be reached within 15 years, but that intermediate goals such as textual syntax and semantic analysis will have effects significant enough to make prediction of the final effect impossible. Spelling it out in more detail, if a system can parse speech for syntax and semantics, it must a fortiori be able to parse text since the recognition problem is much easier; and this will revolutionise natural text input to computers (e.g. for expert systems, and database enquiry).

Possibly because it is some years away, the E&T market does not appear interested in voice input.

4.3.3 Video and audio

Video:

The main advances in video will be in the direction of higher resolution and better storage methods. We believe there is also an interest in genuinely 3-D display generators or in single flat

screen systems not requiring special spectacles; however one should be aware of the communications bandwidth requirements that any such development could create if it is not based on stereoscopic illusion of depth.

High-definition television:

Within the next five years, we expect to see digital image processing within TV sets to produce an apparently higher quality image from "standard" PAL/NTSC/SECAM signals - see Parker ( ).

A completely separate activity is the development of a "genuinely" higher-resolution system based on more scan lines and probably a different aspect ratio more akin to cinema screens. For example the Japanese have proposed a system based on 1125 scan lines, 60Hz amd 5:3 aspect ratio. Other countries have been investigating similar systems. We expect that a standard proposal will be produced in the next few years, either by international agreement or by imposition of de facto standards by certain groupings of TV manufacturers, and service suppliers

However, such a high resolution TV receiver system also needs a delivery system. The high bandwidth requirments make it impossible in many countries to use the regular UHF TV bands, so that one is left with either satellite or cable channels. Hence a service could apparently start fairly soon. However, there is as usual the question of compatibility with previous levels of TV service. For example, in the UK the ITV authorities have proposed a satellite TV system call MAC which is incompatible with existing services, whereas the BBC have proposed an extension of PAL which is compatible. Currently the UK Government has adopted MAC as a standard, but it is unlikely that the rest of Europe will. Consequently we are in a not uncommon situation (qv. videotex), where standards arguments could delay by some years the development of a technically feasible service.

Nevertheless, we expect to see the gradual extension of high definition TV services from a starting date of about 1988.

There is no evidence that the E&T market as a whole is particularly interested in HDTV. However, certain applications will benefit from any improvement in image quality as and when it comes.

Video-cassettes:

Video-cassette recorders will continue to increase in popularity and we do not expect the impact of video-disc to have any effect on the consumer market for video-cassette players. Some people take the view that cable (and satellite) TV systems could absorb

that part of consumer discretionary income oriented to video-cassette, but our view is that the market for video-cassette recorders is far enough underway that the customer will see the time-shift advantages that video-cassette gives him when he gains connection to cable systems. The advent of home TV cameras will give a further fillip to VCR sales.

We believe that in a vocational E&T application oriented to home-based students, one can now accept the VCR as a device one can expect the customer to have (as indeed the audio-cassette recorder has been for several years).

Video disc:

Much has been written about the future prospects for video-disc, and we do not want to add to it unnecessarily. Our view is that after several false starts, the laser video-disc has a future in the business market (including E&T) but not as a consumer device for the next ten years. We do not expect current laboratory work on multiple-recordable video disc to come to business fruition soon enough to affect this judgement.

The E&T market wants the laser video-disc in its interactive mode; indeed, that is one of the few specific products other than micros that they do want.

It requires more detailed market research to forecast the share of the future video-disc market that E&T will have, but our judgement is that E&T will have a disproportionately large share of this market, and indeed that the success of laser video-disc is largely dependent on its success in the E&T market subsector.

Audio:

The consumer audio market is characterised by the presence of one mature technology (audio-tape recording) and one nascent technology (compact disc), together with customers who are used to read-only media (conventional gramophone records) and prepared to pay for well marginal increases in reproduction quality (the hi-fi market).

Compact disc:

For the above reasons, we believe that the compact digital disc has a consumer future whereas the laser video-disc does not. The compact disc allows reasonably high-speed recording of digital data, and in this mode offers an escape from the two perennial problems of error-free data recording on consumer audio-cassettes, and software piracy by re-recording cassettes. The data recorded can of course represent graphical information as well as text, and indeed using a decoder of the sort developed

for alpha-photographic videotex, a large number of still pictures can be stored (though nowhere near as large as for video-disc).

The E&T market has not shown much interest in compact disc, but when they perceive the benefits of the system for data and voice storage, and the lack of a consumer video-disc system, they may well become interested. Indeed, some may envisage a consumer level 'interactive audio-picture' version of the interactive video workstation likely to be used in business premises for E&T activities.

4.3.4 Telecommunications services

In this section we have followed the classification of telecommunications services used in the Arthur D. Little report (and already adopted by us in the chapter on current state-of-the-art in IT).

We shall begin with a thumbnail sketch of the likely telecommunication environments in 1990 and 2000.

In 1990 we envisage the three layers of service as follows:

- Residential customers still largely served by analogue local loops but with about 25% of homes being passed by cable systems (some of which will offer interactive services) - the trunk telephone network almost wholly digital.

- Business customers (even small business, including educational institutions) mostly served by a digital local loop, but with no significant attachment to 2-way switched video services.

- Large business customers with high-speed (2 Mbit/sec minimum) connection into the digital trunk network about 5% served by 2-way switched video (140 Mbit/sec), mostly delivered by satellite links.

By 2000 we would expect that all residential customers (as well as all business) would have digital connection (at least 64 Kbit/s data, plus speech) into the telephone network, and that the various cable networks would either have coalesced into (or been absorbed by) a video network capable of delivering interactive data (one-way video) to all urban homes, and video telephony to any business premises or high-income home, at a price about 5 times that of the base-level telephone charge.

Basic telecommunications services

Voice:

We assume a 10% reduction in real terms in trunk telecommunications costs per annum. Thus, to give a UK example, the cost of a 1-hour trunk telephone call currently costing £3.70 would fall as follows:

1990 £1.97
1995 £1.16
2000 £0.68

The digitisation of the trunk network and local exchanges (including the move to tone rather than pulse dialling) will considerably reduce the problems of the current network referred to earlier. Thus we should have:

a) reasonable (and uniformly reasonable) speech quality

b) low possibility of loss of a connected call

c) low percentage of failed/misrouted calls

d) short call set-up times.

Apart from the obvious advantages for E&T users of ordinary point-to-point telephony, the combination of higher quality of service and lower costs should from 1990 onwards make audio-conferencing an attractive service to E&T organisations serving home-based students.

Telex/teletex:

Telex will have largely died out by 1990, having been replaced in EEC countries by a mixture of teletex and electronic mail via computer store and forward system. Though the service will be used by E&T organisations for administration, we do not expect any teaching-oriented uses of teletex to develop.

Low-speed data services:

By 1990 the business user, including colleges and schools, will be able to have low-cost direct connection to digital networks at speeds up to 64 kbit/sec. The digital networks will be able to offer permanent circuit, packet-switched and circuit-switched services to existing data network customers depending on the type of service the customer was used to; but most new customers will expect (or at least be offered) circuit-switched services.

The residential customer (unless running a business from home) will not have a digital connection to the local telephone exchange. Modest users of data communications will be quite content with 1200/75 modems (CCITT V23) to connect them to data services; those lucky enough (5% connected in 1990?) to be on interactive cable networks will have higher data speeds to the home (64kbit/sec?) but still only a low-speed upstream data channel. The price of V23 modems is now beginning to bottom out (based on US and UK experience) and by 1990 should cost no more than £30.

Users who want higher data speeds will be able to have them, but it is not yet clear what the speed of the "final generation" of dial-up modems will be. We can dismiss the 1200/1200 modem (CCITT V22) as having insufficient advantages given its performance limitations and higher price, and the race is really on between:

a) V22 : 2400 bit/sec as used for teletex
b) V26 : 4800 bit/sec
c) V32 : 9600 bit/sec

The last design uses sophisticated echo-cancellation and error-correction techniques in addition to usual encoding schemes, and is reported to have AT&T and IBM behind it. Given its company pedigree as well as its price-performance advantages and compatibility with in-house data network speeds, we would on balance expect this design to be market leader. A price of about £200 by 1990 is possible, and at that price it would be popular with the residue of the business market who did not have digital connection.

High-speed data services:

See the introduction to Section 4.3.4.

Broadband services:

See the introduction to Section 4.3.4.

Satellite services:

The key point to bear in mind is that "satellite capacity is insufficient to provide advanced services on a large scale" - see Little. Full-scale use of broadband systems (e.g. business use of videotelephony) will require land-based (optical fibre) systems. Any move to high-definition TV (whether for broadcast or videoconferencing) just makes the satellite bandwidth congestion worse.

However, satellites still will play a significant role: in the period 1986-1991 there would be "sufficient capacity ... to stimulate and explore the market" for broadband services.

Radiopaging:

Best regarded in the longer term as a digital overlay on radiotelephony (see next section).

Radiotelephony:

The advent of cellular radio techniques has blown a path through the frequency spectrum congestion problem affecting radiotelephony, and market predictions are bullish. For example, in the US market some commentators see the number of users growing as follows:

1984	15 000	
1985	90 000	
1990	1360 000	(or 2000 000 - 3000 000?)
2000	15000 000?	

(Source: Link Resources as reported in Computer Weekly 11/3/84.)

While European growth may not be as meteoric, due to different regulatory environment, radiotelephony will be a significant force in Europe as well.

Immediate relevance of radiotelephony to E&T is fairly limited, since little E&T currently takes place in moving bodies, except in the military arena. Enthusiasm for short term use in land-based E&T is normally confined to educational social reformers of a certain turn of mind! However, it is reasonable to expect that the ubiquitous availability of medium-bandwidth speech and data communications will have a number of second-order effects which are difficult to foresee. For example, without going the lengths of postulating portable videotelephones by 1990, we consider that:

- future designs of car-based telephone systems (bearing in mind the limitations of the driver as regards viewing screens and touching sophisticated controls) may rely on voice input/output devices;
- mobile systems may foster R&D into small scale display systems for use in portable data terminals;
- railway companies and airlines may gain travellers at the expense of the car because they can offer a "data terminal per seat" capability.

Cable television:

We could not possibly compete with the vast amount written on this subject in the last 12 months, so we shall merely record our view as to penetration, and note some of the difficulties in using the medium.

Estimates for "homes passed" in 1990 vary from about 16% to 30%, but this of course is "passed" not "connected". By 2000 it would be reasonable to assume 100% homes passed in urban areas, and almost 70% of these connected.

Enthusiasm for cable in the E&T market has been highest among those whose viewpoint was both local and education (and who implicitly assumed that their college A/V unit would produce the programmes free). When considering national E&T initiatives, the problems of cable in 1990 are the following:

- isolated systems, meaning separate negotiation with each cable operator;
- low penetration of non-interactive systems compared with alternatives such as VCR;
- particularly low penetration of business (including school and college) premises;
- no national return audio channel even on interactive services.

Another problem is that the alleged multiplicity of channels (50-100) does not lead to an even spread of viewing. Indeed, recent American experience (Economist, January 28) suggests that users clump together on a relatively low number of channels leaving many unviewed for weeks at a time.

In the period 1990-95 it will be more appropriate for national E&T initiatives requiring video with an audio return to be carried on satellite services (as in recent American E&T activities for high-salary staff), or distributed via cassette/disc with a subsequent audio teleconference.

Value-added services:

Out of the current variety of value-added services on offer, and the many more that market pressures will build on the new digital networks, we shall concentrate on those where there is a current, or at likely plausible, E&T interest.

Audio teleconferencing:

This has been discussed earlier in the telephony sub-section. We can expect its use to grow, but by 1990 the business E&T sector is likely to combine some degree of visual imagery with the audio (remember that the minimal connection to business premises will be audio plus 64 kbit/sec data). In the residential community, the fact that audio conferencing requires a level of organisation and synchronisation in time may take the edge off its growth in an era of concentrating on individualised learning, the lost growth going towards a combination of one-to-one telephony and electronic messaging (including voice mail).

Videotex:

The main question to be asked about the long term future of videotex is whether it will exist as an identifiably separate technology in 10 year's time, although whether this means it has "won" or "lost" depends on your point of view. At the moment its use is growing fast, although little is happening in the E&T sector, despite a good deal of amateurish enthusiasm.

Currently the videotex situation has some points in common with cable television. For example:

a) we have different national standards even within Europe, and yet another standard in North America, to say nothing of Japan;

b) the national videotex services offer a lowest common denominator, with little technical scope for E&T use;

c) there are a large number of private videotex systems, but relatively few are connected to the national videotex system, and even fewer to each other.

Harmonisation efforts are under way and the new CEPT alpha-mosaic videotex standard will go into service shortly in Germany. Other European countries pay lip-service to it and may adopt it eventually. However, there are problems: the CEPT standard is over-engineered in the traditional PTT fashion, and difficult to implement in full on the popular business and home microcomputers.

There are separate problems for the residential videotex market. Conventional European wisdom is that the next step after textual videotex information is photographic, for catalogue application (travel bookings, house hunting, shopping at home). However an adequate photographic system requires a digital channel, and since digital phone connection is likely to be largely confined to the business market up to 1990, the only outlet for alpha-photographic videotex is via the limited number of interactive cable system. Furthermore, photographic displays are impossible

to provide on the current and indeed next generation of business microcomputers (largely American and Japanese, of course).

This gloomy analysis only affects badly those EEC countries who choose the CEPT system as their base level and so Britain and France among others will escape the worst effects.

By 1986 one forecast is that Britain will have 1 000 000 videotex terminals and Germany 400 000 (Butler Cox). In the US the videotex home banking market alone is estimated at 10% of homes by 1991. (Frost and Sullivan). European forecasts depend initially on resolution of the two technical/PTT-political problems described above. In current trends, the UK market is likely to be the freest to develop.

The E&T market likes videotex: it encapsulates in a simple way a number of ideas they intuitively know are important (cheap terminals, cheerful displays, low-cost networking). However when they try it they get easily disheartened, often assuming that when they run into difficulties on the public videotex system, this means that no videotex system can cope with their requirements.

Facsimile/slow scan:

This is of little relevance to the E&T market. As and when facsimile is absorbed into alpha-photographics videotex (or slow-scan television), it is likely to find some role in teleconferencing applications in E&T.

Electronic mail:

Most microcomputer users who have data communications capability will make use of electronic mail facilities, although often without consciously realising it. Thus the likely electronic mail market is potentially very large.

The E&T market likes the idea of communicating personal computers; possibly it appeals to their ideas of communicating personal computers; possibly it appeals to their ideas of individual education and fighting back against the corporate state. When one gently explains the investment required in store-and-forward mainframes and data networks required for a working, cost-effective system, they tend to lose interest in installing it themselves. However, there certainly is a market niche for companies able to deliver a painless, economical electronic mail service to E&T users.

Voice mail:

Voice mail is the digital equivalent of a centralised answering machine. Some pundits believe that voice mail will provide a solution to the keyboard shyness of the European executive; however, voice mail systems suffer from two disadvantages:

- naive users are almost as worried by telephone answering machines as they are by keyboards;

- a voice mail system either has to have a voice recognition subsystem (e.g. to recognise user codes and priority information) or to allow keyboard input (in which case one might as well allow keyboard input for text).

For these reasons voice mail systems are likely to develop out of electronic text mail systems by the addition of a "voice footnotes" facility. As such, they will develop as premium services on top of electronic mail systems and hence will not have tariffs attractive to the E&T user.

The E&T market appears to show little interest in voice mail systems; however, it shows considerable interest in systems which add audio output to CAL or still pictures, and it is likely that developments in voice digitisation for voice mail could have a beneficial effect in related areas of more interest to the E&T market.

5. SOME OBSTACLES TO THE INTRODUCTION AND APPROPRIATE USE OF IT

We have grouped the points made to us on this subject under the headings of:

a) Educational problems - primarily related to curriculum issues, educational methods/techniques and course material (including courseware).

b) Technological problems - primarily related to educational/training aids, equipment and software

c) Structural/organisational problems - affecting the whole field of educational technology.

d) Resourcing problems - costs and investment issues.

5.1 Educational problems

5.1.1 Lack of co-ordinated information on the availability and effectiveness of educational/training aids ("what is available, who is using it and for whom, how was effectiveness measured").

5.1.2 "Problems of different sectors of education and training are different, i.e. no single solution or single product likely to satisfy all needs."

5.1.3 Lack of solid theoretical foundation for teaching/learning and the appropriate use of media, in particular computer-aided learning.

5.1.4 Lack of professionals with the necessary combination of skills to exploit technological aids (learning psychology and educational technology).

5.1.5 Slow integration of IT-based systems into teacher training curricula; thus resources that are already there are not fully exploited ('Subtraction problem': what to remove from curriculum to allow more time for IT?)

5.1.6 Lack of sufficient high-quality, well-documented course materials which could be used to demonstrate the advantages of IT-based methods. The few good systems are mostly in English.

5.1.7 Fears of de-socializing effects of individualised learning techniques (e.g. computer-aided learning, computer-based training).

5.2 Technological problems

It is apparent from virtually all responses that technological obstacles are not considered to be of primary significance. The following three points, however, appeared sufficiently frequently for them to be included here:

5.2.1 Lack of cheap, easy-to-use, reliable and flexible aids to learning.

5.2.2 No adequate technical facilities (primarily, software tools) available to educators and trainers to make rapid, easy, low-cost changes to existing courseware.

5.2.3 Transferability of courseware is difficult due to differences in languages, lack of standards, diversity of percieved needs. This also inhibits transfer of good practices, and re-use of modules.

5.3 Structural/organisational problems.

5.3.1 Fragmentation of the educational/training sector - no identifiable community of qualified educational (information) technologists; no identifiable market for manufacturers to sell into, leading to a lack of interest in the sector by large manufacturers, lack of an organised user representation at international level.

5.3.2 Institutional inertia and mistrust of new technologies, both in education and in industry. Organisational problems in introducing new methods, even when management is willing.

5.3.3 Lack of intellectual rights legislation to protect software and courseware.

5.4 Resource problems

5.4.1 "The start-up problem" : high initial costs of equipment and courseware creation, as an 'add-on' to existing facilities, lead to cash-flow problems.

5.4.2 Lack of convincing cost-effectiveness information or even of measures of it.

5.4.3 Educational and, particularly, industrial training are not financially highly rewarding either for trainers or for the manufacturing/service sections. This leads to a shortage of high-quality manpower and convincing products.

5.4.4 High development costs for manufacturers and service providers.

6. SOME SUGGESTIONS TO OVERCOME THE PROBLEMS

In this section we list a number of suggestions for overcoming the sort of problems outlined in the previous Section. They are drawn together from two primary sources, summarising:

- suggestions put forward by our contacts on actions which they see as important in making better future use of IT in education and training;
- ideas which emerged during a meeting of experts organised for this Study - background materials to many of these are contained in the transcripts of Annex 5.

Essentially, many of the points made here have been put forward by a number of different people, with minor differences in wording. The suggestions here are grouped under the same headings as the obstacles listed in Section 5.

6.1 Educational Proposals

6.1.1 "Encourage exchange of experience among Member Countries with regard to:

- teacher/trainer training in IT
- methods of courseware development (and in general, methods of IT applications for education and training)
- evaluation of results of computer education (and of other IT applications)".

6.1.2 "Start international co-operation in the development of:

- libraries of high quality, transferable courseware
- computerised test question banks."

6.1.3 "Establish a European database of available high-quality courseware".

6.1.4 Develop courses in a number of areas:

- "IT-based courses on educational technology for existing staff, administrators, managers ".
- "multi-lingual IT-based courses in areas of community interest, e.g. re-training to facilitate the introduction of new technologies";
- "IT-based courses for general learning of foreign languages. Potentially enormous demand, of great social benefit to community (each Member Country could contribute). Natural language is an ideal vehicle for advanced IT".

- "a course on 'Hands-on Introduction to IT in education and training' running on all current micro-computer systems";

- "courses on training skills, in particular CBT";

- "IT-based courses for Educational Systems Analysts/Educational Information Technologists".

6.1.5 "Provide public education on IT topics using TV, videodisc, CBT, etc".

6.1.6 "Develop a training programme on topics generated by/required by ESPRIT".

6.1.7 "Initiate a basic research programme into learning processes, and the social and educational effects of media (e.g. of individualised learning, group learning, distance learning)".

6.1.8 "Encourage experimentation and development of courseware for a variety of vocational subjects, e.g. in fundamental subjects like mathematics, electronics, mechanics, etc.".

6.1.9 "Initiate studies of existing good practice in matching educational technology to educational aims, and to the level and subject of presentation; disseminate results".

6.1.10 "Prepare 'effective practice guides' on course design and man-computer interface".

6.2 Technological Proposals

6.2.1 "Specification, design and prototyping of an 'educational workstation'".

6.2.2 "Encourage exchange of ideas on criteria for good educational hardware and system characteristics".

6.2.3 "Educational hardware, network and software standards".

6.2.4 "Improved man-computer communication devices, including:

- robust keyboard
- cheap printing
- cheap overhead video screen
- cheap speech input/interactive audio
- electronic pointing device based on gesture".

6.2.5 "Low-cost network (e.g. viewdata) for delivery of courseware, electronic mail for communicating with other students/tutors, rapid feedback on progress, etc".

6.2.6 "Promote network development and applications between Member States (e.g. access to databases, teleconferencing)".

6.2.7 "Modularised, integrated approach to courseware development (authoring systems)".

6.2.8 "Create a European intelligent authoring system".

6.2.9 "Ensure portability of existing authoring systems".

6.2.10 "Integrate IT media into standard operating systems".

6.2.11 "Promote aids to transferability of courseware".

6.2.12 "Create a European educational/training user interface system".

6.2.13 "Support preparation of course production tools via 'half-products' e.g. to be used in the 'training of trainers'".

6.2.14 "Pilot series of video-discs and visual database based initially on existing materials".

6.2.15 "More powerful educational computer language than LOGO".

6.2.16 "Multi-media books, with translation into the national languages".

6.3 Structural/organisational proposals

6.3.1 "Establish centres with sufficient 'critical mass' of educational technologists to further research, development, demonstration and evaluation".

6.3.2 "Establish a permanent European network of specialists in IT in E&T and an information network for co-ordination and eventual collaboration of groups working on and applying advanced educational technologies".

6.3.3 "Stimulate collaboration and encourage closer links between educators and industry by e.g. joint course development, joint research programs (expert systems, video-disc systems, etc.) and exchange of personnel".

6.3.4 "Convene regular meetings, conferences and workshops of educational technologists at international level".

6.3.5 "Encourage the shared use of expensive courseware, e.g. by short-term feasibility study, co-production pilot projects, multilateral working groups on standards".

6.3.6 "Take steps towards the resolution of copyright/intellectual property protection problems".

6.3.7 "Set up working groups on assessment of needs and technical definitions".

6.4 Resource proposals

6.4.1 "Conduct cost/benefit studies on the use of IT-based systems in E&T:

- develop a methodology for costing studies;
- collect existing data on the use of IT-based E&T systems;
- carry out studies on e.g. hardware implementation, operating costs, or on software development, documentation and exchange with emphasis in collaboration between groups within the Community".

6.4.2 "Support for companies (e.g. by subsidies and manpower) which introduce training schemes based on IT".

6.4.3 "Establish a European co-ordinating/facilitating agency for pooling and allocating training resources within industry".

7 A PROPOSED STRATEGY

In this concluding section we wish to put forward a synthesis of the ideas which have emerged from our Study, in the form of a set of coherent actions, for implementation over a period of about five years.

7.1 Aims

The aim of the strategy is to stimulate the appropriate use of IT-based educational and training systems by providing 'added-value' and a 'European dimension' to the various national initiatives. In particular, support from the Commission should focus on:

1) a programme of basic research on the appropriate use of technology as an aid to learning;

2) encouraging co-operation, and the spread of good practices and products among the national education and training sectors;

3) identifying and giving initial support to new developments (products and services) which are cost-effective only when implemented on a multi-national scale;

4) ensuring that the educational and training sectors, as one of the most important application areas of information technology, can make a significant contribution to, and derive a signficant benefit from, the full range of European initiatives in information technology R&D and application.

7.2 Approach

To achieve these aims we recommend the following approach

a) In relation to Aim 1, we recommend a programme of research and development projects, outlined in greater detail in Section 7.4 below. An important feature of this programme is that it involves not only the design and development of new products (based on the recommendations of Working Groups) but also their direct application in achieving specific educational and training objectives, through the production of educational materials.

b) In relation to Aim 2, we recommend the setting up of a number of specialist working groups to deal with the technical and economic issues (identification of needs, specification of products and services, their evaluation, etc.) of advanced educational technology. These should involve experts from both the educational and training

sectors. We also recommend that individuals and groups who are involved in the working groups and in the implementation of this strategy should be interlinked by a communication network (e.g. by participation in Eurokom) which provides electronic mail/computer conferencing facilities.

We further recommend the publication of a series of 'guides of good practice', cost-effectiveness studies, reviews and assessments of products, as outputs from the working groups, or as commissioned studies, or as part of the documentation of contracts placed by the Commission in this field. There are to be up-dated to include the results of projects under a) above.

c) In relation to Aim 3, we recommend an emphasis on educational and training problems and applications in some of the areas of activity of ESPRIT, in particular in:

- advanced information processing systems (as aids to learning, knowledge representation, communications, storage and retrieval of information, etc);
- office systems (many educational and training systems have an administrative component);
- infrastructures (support and co-ordination).
- micro-electronic and software engineering developments these are relevant in reducing the cost and improving the effectiveness of IT-based authoring and presentation systems.

Overall, we recommend an approach which is based on the exploitation of existing hardware and the emerging software aids, in conjunction with advanced communication facilities, and combined with a programme of basic research and system definition. Co-ordinated work along these lines will lead to a new generation of learning aids by the end of a 5-year time span.

7.3 Framework

We believe that advanced educational technology will make its most noticeable impact in promoting distributed learning.

By distributed learning we mean learning which may, but need not necessarily, take place in an institutional setting, and which gives substantial control of timing, learning strategy, and location to the learner. It combines distance learning, personalised learning, and open learning. It offers the

possibilities of independent or small-group learning, in a multi-media environment.

The table below shows some of the activities involved in distributed learning, and the role of technological aids in these activities.

The main advantages of distributed learning accrue to thelearner in increased flexibility and better access to high-quality learning materials. But the educator/trainer also gains by being able to tailor available learning materials to local requirements, and being able to offer a rich learning environment which actively involves and motivates the learner. The main contribution of IT is to make distributed learning effective.

7.4 A programme of research and development

As a move towards distributed learning, and towards the appropriate use of advanced educational technology more generally, we recommend a phased programme consisting of:

Phase 1 (1984/1985)

1) the development of learning materials based on existing technologies, but in the distributed learning mode in, for example:

   - a "Hands-on introduction to the Use of IT in Education/Training" (for training the trainers/teachers)

   - the use of IT-based tools in industry, management, office, retailing, etc.

   - basic vocational subjects, etc.

   The preparation of such materials will inevitably expose some of the problems and needs of the 'state-of-the-art' technology and point the way towards desirable future developments.

   We recommend that such learning materials should be developed by joint teams from academia and industry/business. Their distribution on a Community scale (where appropriate) should be organised and resourced from Community funds.

ACTIVITIES IN DISTRIBUTED LEARNING

	ACTIVITY TYPE	TECHNOLOGICAL AIDS
I	Educational materials development process	
1.	Identification of needs (employers, government, learners, educators), market research.	1. Interactive databases, low-speed communications networks, teleconferencing.
2.	Development of objectives, curriculum, test strategy, etc.	2. Communication support for trainers. Tools for the representation of knowledge and skills. Databases of curricula and proven materials electronic libraries.
3.	Resource organisation and management.	3. Management tools (decision-making project control), office automation.
4.	Selection and delivery of existing learning materials.	4. Databases on availability, quality, costs etc., of existing materials. Computer-ised production of text.
5.	Production/modification and testing/validation of new learning materials. Documentation.	5. Multi-media production systems (text, data, voice, picture).
6.	Presentation.	6. "Workstations", (personal text, voice, picture, data systems) linked to networks, e.g. by cellular radio broad-band cable, etc. Repair and maintenance aids. Multi-media books.
7.	Evaluation and improve-ment of materials.	7. Remote CML, on-line updating.
II	Tutoring, guidance counselling	Computer-managed learning. Tele-conferencing (real-time). Tutored video (small groups). Electronic mail.
III	Administration	Computer/communication-based registration, testing, progress, fees systems
IV	Support services	Electronic libraries. Aids for handicapped.

2) The drawing up of design specifications (by Technical Working Groups convened by the Commission), followed by a Design Competition for :

a) an educational workstation

b) improved human-computer interface devices, e.g. speech input/inter-active audio; overhead electronic screen and pointing device based on gesture; "electronic book", a European educational/training user interface;

c) European standard telephone modem capable of handling both data and speech simultaneously on one line, at low cost;

d) aids to the creation of high-quality portable courseware.

3) The initiation of a programme of basic research into:

- cognitive processes in IT-mediated learning

- appropriate and inappropriate uses of IT in learning

- the social and educational effects of media (e.g. in individualised learning, group learning)

- 'intelligent' authoring systems.

Phase 2 (1985-1989)

1) The development, prototyping, testing, manufacture and diversification of educational/training systems based on the products designed in Phase 1.

2) The continuation of the programme of basic research started in Phase 1.

3) The setting up and maintenance of "electronic libraries" of courseware and other learning aids.

4) The development of courses of Community interest exploitation of new learning aids and systems e.g. in:

- community languages

- skills required or brought about by the application of products developed under ESPRIT

- the training of educational information technologists, etc.

5) The exploitation of new telecommunications services for education and training purposes (e.g. professional updating), electronic mail, teleconferencing.

6) The development of cost/effectiveness assessment techniques, and their application to projects undertaken within the programme.

7) The continuation of the work of Technical Working Groups on the definition and evaluation of new products developed for the E&T market, and the assessment of products of relevance initially aimed at other markets.

8) The exchange of personnel between educational and industrial environments; joint meetings, and dissemination of new developments.

7.5 Resourcing

We recommend that Commission support be provided for the above programme by :

a)	design competition	20%)	
b)	joint industry/academic projects including the development and production of learning materials	50%)	of total cost
c)	academic projects	100%)	
d)	distribution of learning materials of Community-wide interest	100%)	

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OPPORTUNITIES FOR INFORMATION TECHNOLOGY-BASED ADVANCED EDUCATIONAL TECHNOLOGIES

Final Report
for the Commission of European Communities

Volume 3 : Annexes

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Acknowledgements

PREFACE

This Report contains the final results and conclusions of a six-month study commissioned by the Information Technology Task Force of the CEC. It is presented in 3 separate volumes:

Volume 1 : Executive Summary
Volume 2 : Main Report
Volume 3 : Annexes

The work under the contract has been undertaken by a team comprising: Dr Peter Zorkoczy (Project Director), Dr Paul Bacsich, Dr Tony Bates, Dr Diana Laurillard, Dr Tim O'Shea and Prof J J Sparkes, with the assistance of Maurice Geller and Carolyn Shaddick, and with contributions by Dr Tony Kaye and Jane Henry.

ANNEX 1 : Statistical summary of responses to questionnaires

Table 1: Questionnaire recipient-breakdown by country and by grouping

	Co-ordinators & Educators	Users of Trained Manpower	Manufacturers & Service Providers	Totals
EUR	5	2	1	8
B	17	12	1	30
DK	31	10	3	44
D	36	14	2	52
F	12	9	5	26
L	18	1	1	20
I	24	4	1	29
L	1	1	0	2
NL	31	19	3	53
UK	150	100	33	283
GR	2	4	0	6
	327	176	50	553

Table 2 : Responses to date - breakdown by country and by grouping

	Co-ordinators/ Educators	Users of Trained Manpower	IT-Manufacturers & Service Providers	Totals
EUR	5	0	0	5
B	5	6	1	6
DK	11	3	2	16
D	11	6	2	19
F	2	1	0	3
IRL	9	1	0	10
I	5	0	1	6
L	0	0	0	0
NL	11	1	1	13
UK	53	16	11	80
GR	3	1	0	4
	115	28	19	162

ANNEX 2 : LIST OF VISITS

DENMARK

Christian Rovsing International A/S

Christian ROVSING
Olav HOLST - Senior Consultant
COPENHAGEN

***

DIEU - Danish Engineers' Post-Graduate Institute

M.JENSEN - Head of Industrial Division
Technical University, LYNGBY

***

Poul HANSEN
Commissioner on Electronic Media (Ministry of P&T)
Chairman, DANMEDIA - IT research and promotion society
COPENHAGEN

***

Danmarks Radio

N ENGEBERG-PEDERSEN - Head of Educational Broadcasting
Palle MOGENSEN - Deputy Head
COPENHAGEN

***

Danmarks Sparekasseforening

L. Kvistgaard JAKOBSEN - Head of Education Department
COPENHAGEN

***

Kobenhavns Handelsbank

Gert PEDERSEN - Training Manager
COPENHAGEN

***

Teknologistyrelsen (Industriministeriet)

Karl Erik JESSEN (et al) - Council of Technology secretariat
National Agency of Technology, COPENHAGEN

Dansk Datamatik Center

Prof Dines BJORNER

Professor at the Danish Technical University
Chairman, Advisory Council for Information Technology
LYNGBY

***

Bjerre LAVESEN - Consultant: 'CAL Pioneers'; contributor to 'IT in Education and Vocational training in EEC' (L.A. Gilbert for CET, 1982)
FREDENSBORG

***

Federation of Danish Mechanical Engineering and Metalworking Industries

Mr BRODAM (et al)
COPENHAGEN

***

FRANCE

IDATE - Institut pour le Developpment el l'Amenagement des Telecommunications et de l'Economie

Nicole MERCIER - CGP : Communication de groupe et professionelle
Alain Veyret; Catherine VOGLIMACCI-STEPHANOPOLI; Daniel DELPUECH
34000 MONTPELLIER

***

Credit Agricole

Jean FAVRY - Directeur du Departement ERP, IFCAM (Credit Agricole Central Training Institute)
Marie France REINBOLD; Claire MEUNIER-THOURET; BURET - IFCAM, Paris

***

Caisse Regionale de la Somme
Bernard JAQUET - Directeur de la Formation
AMIENS

***

IRELAND

NIHE - National Institute of Higher Education

Chris CURRAN - Head of Distance Learning
Dr David OWENS - Head of Instructional and Educational Media
Dr Tony MOYNIHAN - Head of School of Computing
Glasnevin, Dublin

***

AnCO - Industrial Training Authority

Raymond BYRNE - Director, Training Advisory Services
Kieran O'DONOVAN - Manager, Training and Development
DUBLIN
David KENNEDY - Section Head, Loughlinstown Training Centre

***

Dudley DOLAN
Director of Beecom Ltd - consultancy: management services to industry, commerce, government on IT training etc.
Lecturer in Computer Science, Trinity College
Dundrum Castle, DUBLIN

***

Irish Times

Desmond P.BURY - General Manager, Irish Times Training
DUBLIN 1

***

Michael SHERWOOD-SMITH
Lecturer, University College Dublin
Consultant to ACOT - Agricultural Training Authority
Computer Science Dept. UCD,Belfield, DUBLIN 4

***

Sean CONNOLLY - Revenue Commissioners, DUBLIN
Chairman, Irish Computer Society Education Committee

***

NBST - National Board of Science & Technology

Paul HOLDEN
Ballsbridge, DUBLIN

***

Paul McDERMOTT - Phillips Data Systems
IBETA Council & Education Committee

***

Michael O'TOOLE - Arnott & Co
Irish Federation of Computer Users
CECUA

***

Alan MULLALLY - Irish Sugar Company
Computer Industry Joint Education Committee

***

Patrick PERRY - University College Dublin

***

ITALY

ENI - Ente Nazionale Idrocarburi

Dr.Umberto RICASOLI - direzione per il Personale e l'Organizzazione
Responsabile Fondo Sociale Europeo e Riconversione Industriale
Dr.Pier Luigi CELLI - Studi e Formazione
00144 ROMA

Dr.Luano BISCONTI - Central Training Manager
ANIC, S.Donato Milanese
Dr.Carmine CUOMO - Director of Personnel
EniChem Polimeri, S.Donato Milanese

***

Prof.Umberto PELLEGRINI
Professor of Applied Electronics, University of Milan
Chairman TECNETRA - "technology transfer"; technological consultancy services for industry
MILANO

***

OLIVETTI

Dr.Aldo GANDOLFI - Education Market Development Manager, Corporate Marketing
Ing.C.Olivetti & C,SpA, 10015 IVREA

ANCIFAP - Associazione Nazionale Centri IRI Formazione Addestramento Professionale

Dr.Raffaele BOTTA- Responsabile 'Staff Didactica'
Dr.Rodolfo PARLATO - Responsabile 'Ricerca e Sviluppo'
NAPOLI, CAP 80143

***

IFAP - Istituto per la Formazione e l'Aggiornamento Professionale Gruppo IRI

Serena BALDASSARE - Formazione Formatori e Metodologie Didattiche
00185 ROMA

***

Prof.Stefano CERRI
Di[partimento di Informatica, University of Pisa
56100 PISA

***

NETHERLANDS

Open Universiteit

FHD GASTKEMPER - Hoofd Mediakunde
Drs G van ENCKEVORT - Hoofd Onderzoek und Evalatuie
6419 HEERLEN

***

Drs.Joost BREUKKER - Vakgroep Functilieer
Psychologische Labs, University of Amsterdam
1018-XA AMSTERDAM

***

Phillips International

N.HAZEWINDUS - Director, Corporate Product Development
J van OERS - Director, Corporate Training

Phillips Research Laboratories
Dr.Dirk KROON

EINDHOVEN

***

Technical University, Eindhoven

M.SAMSON - Director, AV Media

***

Twente University

Dr.J.MOONEN - Director, COI Unit
ENSCHEDE

***

INTERNATIONAL

European Institute of Social Research

Dr.Ladislav CERYCH - Director
PARIS

***

CEDEFOP - European Centre for the Development of Vocational Training

Michael J.ADAMS
Burkardt SELLIN
William McDERMENT
Gerde CHOUME
BERLIN

***

UNITED KINGDOM

MSC - Manpower Services Commission

Len GOULD - Head, Training Technology Section
Alan LISTER - Training Technology
Moorfoot, SHEFFIELD

***

National Health Service Learning Resources Unit

Ian TOWNSEND - Education & Training Adviser
Hon Secretary, NUMINE - Network of Users of Micros in Nursing Education
Jean HEATH - Information Officer
SHEFFIELD

IPC Magazines Ltd,

Clifford BOOTH - Head of Training Centre
Chairman, IPC New Technology Committee
LONDON

***

Ford Motor Company

Tony LEWIS - Head of Training, Europe
Dagenham, ESSEX

***

Manpower Ltd,

Mrs.L.M.BENNETT - Director of Marketing
Slough, BERKS

***

GRE - Guardian Royal Exchange Assurance

W.A.BROOKER - Head of O&M
LONDON

***

SMDP - Scottish Microelectronics Development Programme

Alistair THOMSON - Depute Director
Dowanhill, GLASGOW

***

MEDC - Microelectronics Educational Development Centre

Peter WILLIAMS - Director
Walter PATTERSON - Senior Lecturer
Paisley College of Technology , PAISLEY

***

SED - Scottish Education Department

Walter BEVERIDGE - HMI
SED, EDINBURGH
Donald MACK - HM Chief Inspector
SED, GLASGOW

***

MSC - Scotland

Alastair PROCTER - Development & Operations
Training Division, MSC, EDINBURGH

***

BBC

Robert McLEISH - Head of Management Training
Jean NUNN
J.RADCLIFFE

***

GEC

John LORIMER - Controller of Training, GECOM

***

General Technology Systems Ltd.

Iorweth EVANS - Director
D.CASHMORE
Brentford, MIDDLESEX

***

CET - Council for Educational Technology

Geoffrey HUBBARD - Director
Vincent THOMPSON - Deputy Director
LONDON

***

W.H.Smith & Son

Peter BOWEN - Head of Training Division
Neil McVICAR - Head of Management Services Division
Abingdon, OXON

ICETT - the Industrial Council for Educational & Training Technology

J.M.WRIGHT - Secretary
B.J.F.HALLER - Chairman, VISTA (Video & Information Systems Technology Association of producers and distributors in teaching and training)
LONDON

***

LGTB - Local Government Training Board

Eric BARTY - Senior Training Adviser, LGTB IT Project
Luton, BEDS

***

Marconi Instruments

B.RIX - Training Systems Manager
Dunfermline, SCOTLAND

***

CEDAR Project

Nick RUSHBY - Director
Imperial College, LONDON

***

Department of Trade & Industry

M.COHEN
P.WALLER
F.HUNT

***

International Institute for Communications

J.HAWKINS - Director
LONDON

***

Cabinet Office

Roger COURTNEY

***

Ministry of Defence

Wing-Commander P.GROVES

***

ASTMS

Tim WEBB - National Organiser

***

ISTEL Ltd. (formerly British Leyland Systems)

J.LEIGHFIELD - Managing Director

***

Department of Education And Science

B.BAKHRADNIA - Secretary, Further Education

***

Further Education Unit, DES

W.CONGLETON - Deputy Director

***

BMA - British Medical Association

Dr.J.DAWSON - Director, Professional Services

***

DELTAK Ltd.

Jack HEAFORD - Managing Director

***

Interactive Computer Systems Ltd.

Michael GROVES - Director

***

IBM (UK) Ltd.

Margaret SCHOLEFIELD - Educational Adviser

***

Polytechnic of the South Bank

P.JINKINSON et al. - Director, Extra-Faculty Unit
LONDON

***

Intra Ltd (Computer-Based Training)

G.HOLLAND - Director

***

NEDC - Sheffield

***

British Telecom

Dr.Jim COWIE - Long-term Strategy Department
CAMBRIDGE

Gerald ROUTHORN - Network Planning Department
LONDON

John THOMPSON - Deputy Director, Research Laboratories
IPSWICH

***

British Standards Institute - Milton Keynes

***

NPL - National Physics Laboratory

Robert WATSON - IT Division
Teddington, MIDDX

***

PIRA - Printing Industry Research Association

John BURKINSHAW - Project Director, Printing & IT Division
Leatherhead, SURREY

***

University of Surrey

Dr.Terry HINTON - Director, Computer-Assisted Learning
Guildford, SURREY

Institute of Manpower Studies

Alan GORDON

Science Policy Research Unit

Tim BRADY
University of Sussex

***

Phillips Research Laboratories

Simon TURNER
Redhill, SURREY

***

NCC - National Computing Centre

Patrick RAYMENT
MANCHESTER

APPENDIX 2

PAPER

Education and Training in the EEC Countries
- a survey of publications

Introduction

This survey covers two major areas:
vocational education and training, delivered by public-sector institutions, and industrial training, delivered by private sector employers and training companies.

Section I is on the 'state-of-art',
Section II is on trends and projects,

I State-of-the-Art

I-1 CEDEFOP

This is the most comprehensive and up-to-date reference guide to vocational E&T provision in nine Member Countries. It also includes a socio-economic background survey of each country. At the present time only the French-language edition is available, but an English-language version will also be published.

I-2 "Descriptions of the Vocational Training Systems: United Kingdom" by Anne M. Lewis (MSC). CEDEFOP, 1983.

This is the section on UK of the previous document. It was prepared in 1981, so does not include the more recent British initiatives mentioned below (items 2a and 2b).

I-2a "Technical and Vocational Education Initiative" - leaflet

Manpower Services Commission, UK, July 1983 TVEI is a 5-year pilot scheme to stimulate the provision of technical and vocational education for 14-18 year olds. Its purpose is "to explore and test methods of organizing, managing and resourcing readily reproduced programmes of education of this nature, and the kind of programmes, curriculum and learning methods required for success.

I-2b "Guide to Information Technology Centres" - leaflet

DTI and MSC (UK), March 1982. Description of a scheme for unemployed young people, to acquire practical skills in information technology.

I-3 "Education and the New Information Tecnologies" - provisional draft EEC Commission Services, undated

A set of monographs describing existing developments concerning the introduction of new information technologies in education in each of the ten member states.

I-4 "Microelectronic Technology and Vocational Training Policy" - an interim report, compiled by W.G. McDerment, CEDEFOP, 1980, updated and reprinted edition 1984.

This is a digest of a large number of reports and studies from around the Community countries. It contains many references and a bibliography, largely up to 1980.

I-5 "Information Technology in Education and Vocational Training in the European Community", (Report of a study undertaken for the Commission) by L.A. Gilbert, on behalf of the CET, UK, 1982 (in 2 volumes).

Although this study was undertaken primarily to consider "the exchange of information and experience, the circulation of computer packages, and co-operative research and development", it contains a set of national reports on the status of IT in education and training in Belgium, Denmark, Ireland, Italy, Netherlands and the UK.

I-6 "Computers in Education: National Policy Perspectives" - collection of papers in "European Journal of Education" Vol 17 No 4, 1982.

Includes papers summarizing the state and near-term plans for the use of computers in E&T in Germany, UK, Denmark, Netherlands, and United States. Covers developments up to (and including) 1981.

I-7 "Computer Education in Six Countries; Policy Problems and Issues" - report by L. Cerych for Ministry of Education and Science, The Hauge, Netherlands (June, 1982).

Draws on and enlarges the papers of Item 6 (with Scotland as the 'sixth country').

I-8 "Curriculum Changes in Response to Technological Developments" - a seminar report compiled by W.G. McDerment, CEDEFOP, 1982.

Includes contributions from Ireland, Italy, Denmark, Germany, Netherlands, UK, and Belgium.

I-9 "Final Report of RAF Working Party on Computer-Based Learning" D/DT(ED)(RAF)50/2/1, December 1980.

Reviews the use of CBL by UK and US military and reports on evaluation studies, including costing of pilot projects. Appendix (in separate volume) includes useful reference information.

I-10 "Computing - Training Supplement" 9 February 1984.
Reviews the state of training for the computer industry in UK.

I-11 "New technology and Public Awareness"
Vocational Training Bulletin No 11, CEDEFOP, Berlin, June 1983.

Reviews the achievements of the BBC Computer Literacy project.

I-12 "How CBT Came of Age"
Management Today, December 1983.

II Trends and Projects

II-1 "New Technology, Education and Vocational Training in the USA" - a Visit Report by W.G. McDerment, CEDEFOP, Berlin, 1984 (revised edition).

Presents a view of the interaction between the education system and high-tech companies in Massachussetts, Vermont and California.

II-2 "Robotics Developments and Future Applications" - report of a meeting of experts from EEC countries held in November 1983. By W.G. McDerment, CEDEFOP, 1984.

II-3 "Educational Environments for the 1990's - a discussion document by John Duke, for CED, UK, September 1983.

Discusses policy issues and possible responses by the E&T sectors to the challenges of the post-industrial society.

II-4 "Discussion Document on Educational Policy"
Business and Technician Education Council, UK, January 1984.

II-5 "Computer Facilities for Teaching in Universities" - report of a working party of the UK Computer Board, December 1983.

II-6 "Technological Changes and Social Adjustment" - Commission Communication to the Council COM(84) 6 Final, EEC, January 1984.

Although wider in context, contains a section on "Training Qualifications, Education and New Technologies".

II-7 "Education, Training and the New Information Technologies"
Europe Sociale, No. 00, July 1983, EEC Commission (in French).

Reviews current projects commissioned by the Social Affairs and Education Directorate of the EEC.

II-8 "Software and Courseware for a Multimedia Educational Environment" - 'Clarifying Report'
OECD Centre for Educational Research and Innovation,
CERI/NT/83.07, December 1983.

Considers some issues in the development, distribution evaluation, analysis, procurement and protection of courseware.

II-9 "Microcomputers in Education" - a framework for research by Morley Sage and D.J. Smith, SSRC Consultative Document, June 1983.

Proposals on what work SERC should support in this area.

Computing and telecommunications
some relevant publications

1) Anon "Geostationary satellites: A Checklist", in, Screen Digest, March 1984.

2) Astrain, S "Comment: INTELSAT and the digital communications revolution", in: Telecommunications Policy, September 1983.

3) Computer Board "Specification for a Student Workstation", in: Addendum to Report of Computer Board Working Party on Computer Facilities for Teaching in Universities, January 1984.

4) Economist "Cable television: channels to burn", in: The Economist, January 28, 1984.

5) Hacoker, P "Do we want bigger, better pictures?", in: Television; Journal of the Royal Television Society, January/February 1983.

6) Little, A.D. "European Telecommunications - Strategic Issues and Opportunities for the Decade Ahead", Final Report to the CEC. Arthur D Little International, 1983

7) Mitchell, B.M. "The cost of telephone service: an international comparison of rates in major countries", in: Telecommunications Policy, March 1983.

8) Schmidt, W. "Field Trial of Fiber-Optic BIGFON LAN", in: Telecommunications, July 1983.

9) Szuprowicz, B. "Cellular radio makes an explosive impact on the 80s", in: Computer Weekly, March 1, 1984.

10) Wartmann, H. et.al. "Reflections on the establishment of an integrated broadband telecommunications network on the basis of optical fibre systems", in: Proceedings of the European Federation of Telecommunications Engineers (FTCE) No 3, July-September 1983.

11) Watanabe, T. "Potential for videophones in Japan - A Service Proposal", in: Telecommunications Policy, March 1983

ANNEX 3 :QUESTIONNAIRES

A: Industry, as employers of trained manpower

Provision of Training

1. For what purposes is training being used in your organisation (e.g. operational skills, up-dating, re-orientation, general awareness etc.)?
2. How do you view the role of training within your organisation? What is its perceived value? What kinds of training do you find most helpful?
3. How is training organised? Where does the management responsibility how does it fit into the company structure?
4. Who receives training in your company (i.e. what employee groups)?
5. What training methods are being used (e.g. talks, films, video etc.)?
6. Who produces the training materials? How are they used/presented? Where does the training take place?

The Use of IT in Training

1. What use is made of IT in training in your organisation, and why?
2. What are the IT-based systems employed - what hardware, what software and courseware?
3. What are the systems used for? What are the types and levels of skills being developed, both IT-related and non-IT-related?
4. Why were the systems introduced? What methods did they replace (where applicable)? How were they initiated - by what department, say, or with what information?
5. Who uses these systems - how many trainees, how frequently, for how long? What are the levels of skills and education of the trainees?
6. What evaluation is there of the training methods, and of the trainees' performance?
7. Is any of the software, or other training materials, generated internally - if so, how and by whom? What existing resources are used? How are the materials organised and presented? Where does the training take place?
8. Could you give us case histories, one example each, of a successful use and an unsuccessful or inappropriate use of IT in training? What kinds of factors contributed to the success or failure?

Future Training and IT

1. What changes or developments in the operation of your company do you foresee that training may help with (e.g. greater flexibility of staff deployment, improved internal communication etc.)?

2. What plans are there in your company for the use of IT-based systems for training? Why are such systems more suitable for your purposes?
3. More generally, where do you see IT-based systems being used? Will they change the need for, or the nature of training (e.g. the way in which it is organised, delivered etc.)?
4. Where do you expect to obtain your IT-based training sytems and materials (e.g. produced within the company, bought-in from sister companies, specialist firms etc.) and why?

Costs and Benefits

1. As an estimate, what is the number of employees in your organisation; how many receive training in a year; how much does the company currently spend on training; what sort of percentage of labour costs does this represent?
2. Where it's possible to apportion overheads, how do your training costs breakdown? How much is spent on training materials - hardware,software, courseware, general production overheads? Is that expenditure (in real terms) likely to increase/decrease in the next 5-10 years?
3. How is the use of IT likely to affect overall expenditure on training (e.g. increase expenditure while improving it, save money on training)? How might IT affect expenditure on different types of course, or on different types of budget (e.g. trainers, materials, accommodation/travel etc.)?
4. What criteria do you use to determine whether you get value from your training expenditure? What criteria would you apply particularly to IT-based training systems?
5. Do you need more information about likely costs of providing IT-based training? What sort of information; how could it best be provided for you?

Future Developments

1. What do you see as the problems to be overcome before IT-based systems can be widely applied - educational, organisational, financial, technical etc.? Outline briefly any solutions you see to these problems.
2. Is there adequate information available to you and your organisation about the potentialities, features and availability of IT-based systems or their components? What information do you/would you find helpful in this area?
3. What technical characteristics do you consider important for future systems (e.g. independent/networked; packaged or modular - standardised or customised; multi-purpose/dedicated etc.)?

The Role of the EEC

1. What actions/projects would you like to see undertaken by the EEC over the next 5-10 years to encourage the appropriate use of IT in education/training? For what purpose; on what scale; in what order of priority?
2. In which actions/projects would you or your organisation want to be directly involved (assuming that resources were available)?

B: Educators/Co-ordinators

E&T and the Role of IT

1. In what ways have IT-based systems helped, or are helping, in E&T? Please give examples of succesful and unsuccessful applications. What factors have contributed to success/failure?
2. Are there any areas of E&T where IT has been misapplied or has no role to play?

Future of E&T and IT

1. What plans are you aware of for the future use of IT-based systems in E&T? What needs does each of these applications aim to satisfy?
2. What do you consider to be the appropriate future uses of IT-based systems in E&T? What specific needs will they satisfy?

Costs and Benefits

1. What are the annual costs of providing each of the IT-based services which you described in the section on past and present use? How many people participate, per annum, in each of them?
2. How do the total costs break down into:
   a) equipment
   b) software
   c) courseware
   d) maintenance
   e) other?
3. What criteria of effectiveness do you consider important in determining whether IT-based systems provide good value?

Future Developments

1. What do you see as the problems to be overcome before IT-based systems can be widely applied - educational, organisational, financial, technical etc.? Outline briefly any solutions you see to these problems.
2. Is there adequate information available to you and your organisation about the potentialities, features and availability of IT-based systems or their components? What information do you/would you find helpful in this area?
3. What technical characteristics do you consider important for future systems (e.g. independent/networked; packaged or modular - standardised or customised; multi-purpose/dedicated etc.)?

The Role of the EEC

1. What actions/projects would you like to see undertaken by the EEC over the next 5-10 years to encourage the appropriate use of IT in education/training? For what purpose; on what scale; in what order of priority?
2. In which actions/projects would you or your organisation want to be directly involved (assuming that resources were available)?

C: IT-Manufacturers & Service Providers

1. What products/services is your compnmay providing for the educational and training sectors? Please distinguish between product-related training (e.g. in support of specific IT based products) and educational or training-orientated systems which may rely on IT. What are the advantages and problems of dealing with sectors for your company? (e.g. successful/unsuccessful products/services.)
2. What do you see as potential areas for new IT-based products/services in this sector?
3. What problems need to be overcome to exploit the potential? (e.g. financial, organisational, technical, theoretical?) In particular, what are the cost considerations in developing, marketing and supporting a new product for the educational/training market?
4. What actions by the EEC (including funding) do you consider appropriate to stimulate the development of new products/services for this sector, and their take-up?
5. A possible area of interest on the international scale is standardisation. In your view, are there areas relevant to education and training that should be added to current programmes of standards work (e.g. author languages, low-performance LAN's asynchronous wide-area network services, etc.)? What effect would the existence of standards have in your company's involvement in this market?

ANNEX 4 : Primary documentation list

BRITISH TELECOM
'The BT Integrated Services Digital Network - a description'
England 1983

BUSINESS & TECHNICAL EDUCATION COUNCIL (UK)
'Discussion Document on Educational Policy'
London 1984

CEC
'The European IT-industry : a short overview'
English, Maurice
Brussels 1983

CEC
'Vocational Training & New Information Technologies: New Community Initiatives during the period 1983-87'
Brussels 1983

CEC
'Education and the New Information Technologies: the situation in the Member States'
Provisional Draft
Brussels 1983

CEDEFOP
'Curriculum Changes in Response to Technological Developments'
Seminar Report, compiled by McDerment W G
Berlin 1982

CEDEFOP
'Microelectronic Technology and Vocational Training Policy'
Interim Report compiled by McDerment W G
Berlin 1980, revised 1984

CEDEFOP
'Systemes de Formation Professionelle dans les Pays Membres de la Communaute Europeenne (Etudes Comparatives)'
Berlin 1983

CEDEFOP
'Etude Comparative du Financement des Systemes de Formation Professionelle - Dispositions Legislatives et Reglementaires (FDR, France, Italy & UK)'
Berlin 1980

CEDEFOP
'Technological Change, Employment Qualifications and Training'
Conference Report , compiled by Sorge, Arndt
Berlin 1982

CEDEFOP
'Robotics Developments and Future Applications'
Draft Report of a Meeting, compiled by McDerment W G
Berlin 1984

CEDEFOP
'New Technologies'
Vocational Training Bulletin No.11
Berlin 1983

CERYCH L
'Computer Education in Six Countries: Policy, Problems and Issues'
Report for the Ministry of Education and Science
Netherlands 1982

COMPUTER BOARD FOR UNIVERSITIES AND RESEARCH COUNCILS (UK)
'Computer Facilities for Teaching in Universities'
Working Party Report
London 1983

COUNCIL FOR EDUCATIONAL TECHNOLOGY
'Information Technology in Education and Vocational Training in the European Community' (2 volumes)
Report prepared for CEC by Gilbert, Leslie
London 1982

COUNCIL FOR EDUCATIONAL TECHNOLOGY
'Videotex in Education - a New Technology Briefing'
Thompson, Vincent et al.
London 1982

COWIE J B
'The Future of Education in the Light of Media Changes'
Institute of International Communications, annual meeting
Aruba 1983

DEAN K J
'Microelectronics in Further Education: Some Personal Perceptions'
FEU London 1981

EUROPEAN JOURNAL OF EDUCATION'
Computers in Education: National Policy Perspectives'
Vol. 17, No.4
1982

EUROPEAN TRADE UNION INSTITUTE
'The Impact of Microelectronics on Employment in Western Europe in the 1980's'
Brussels 1980

EUROPEAN TRADE UNION INSTITUTE

'Negotiating Technological Change: a Review of Trade Union Approaches to the Introduction of New Technology in Western Europe'
Brussels 1982

EUROPEAN TRADE UNION INSTITUTE
'Trade Union Use of Information Technology'
Brussels 1983

HARRY K, KAYE A, WILSON K
'The European Experience of the Use of Mass Media and Distance Methods for Adult Basic Education'(2 Volumes)
Distance Education Group, Open University
Milton Keynes 1981

HIMMELWEIT,Hilde
'Reflections on the Likely Utilisation of the Newer Media in the Service of Education'
Institute of International Communications, annual meeting
Aruba 1983

IDATE
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ANNEX 5 : Case study in the use of computer-assisted learning at the Credit Agricole

1. INTRODUCTION

The Crédit Agricole is the largest bank in Europe, and its position amongst the largest banks in the world varies from first to sixth, depending on the fluctuations in franc/dollar exchange rates. It has played the major role in the financing of the modernisation of French agriculture since World War II, and is politically a very powerful organisation. It currently has around 70,000 exployees working in its 3,000 local offices, its 94 regional headquarters, and its two national agencies in Paris.

The structure of the Crédit Agircole reflects its rural and provincial origins: it is that of an association of 94 regional co-operative institutions (Caisses Régionales), each with the status of a private company. Each of these is itself composed of a head office and between 10 and 250 local offices, each of which is, in turn, legally, a private co-operative, with its own president, board of directors, and members. The average number of employees in each Caisse Régionale is around 600-700, although there is a great variation in size between individual Caisses. Altogether, there are about three million co-operative members in the Crédit Agricole, (of whom 70% are farmers) and about five million clients who are non-members. Originally exclusively a rural bank, the Crédit Agricole now has, in addition, an extensive network of urban branch offices. The remaining elements of the Crédit Agricole's pyramid are at a national level. The management, control, and financial co-ordiration of the organisation as a whole is assured by the Caisse National de Crédit Agricole (CNCA), based in Paris, which is a public institution, with a managing director nominated by the Government, and a bi-annual plenary commission presided over by the Minister of Agriculture. The CNCA's board of directors includes a number of elected members drwan from amongst the 94 Presidents of the Caisses Régionales. One of the CNCA's many roles is to act as a central clearing bank for the Caisses Régionales, maintaining the necessary global equilibrium of financial resources and transactions amongst them. Currently the CNCA employs about 2,200 staff.

The second national organisation is the Fedération Nationale du Crédit Agricole (FNCA), with a permanent staff of 150. The FNCA represents the 94 Caisses Régionales and defends their interests vis-à-vis the CNCA and the Government. It provides a forum for meetings and discussions between the presidents and managers of the Caisses Régionales, and provided a number of services in common to all of them (training, insurance, staff matters etc).

The Crédit Agricole also owns, or part owns, around 25 subsidiary companies and organisations, which include, for example, a travel agency (Voyage-conseil) and a property investment firm (Unipierre).

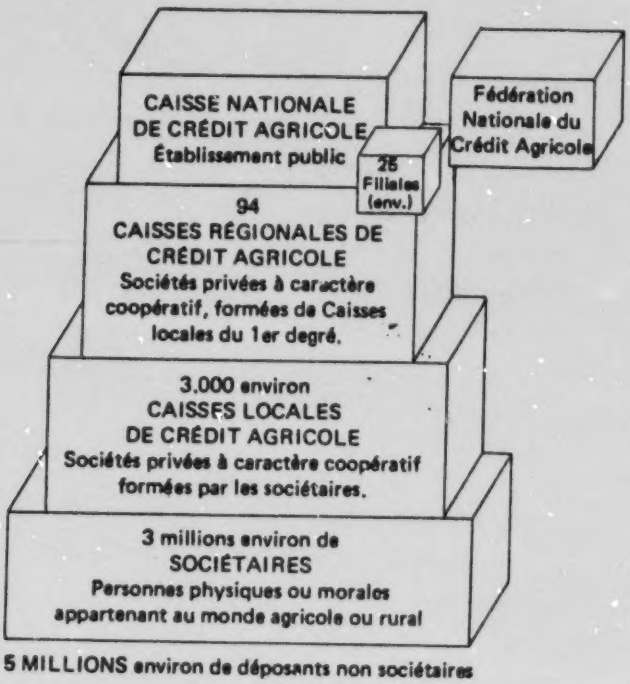

Figure 1: The Pyramidal Structure of the Crédit Agricole

Figure 1 illustrates the general pyramidal structure of the Crédit Agricole. It is important to note that the ultimate control of the organisation lies with the members: at a local level, each office has a president elected from amongst the local members. The President of each Caisse Régionale is elected from amongst the presidents of the local offices, and these presidents in turn form a pool from which are elected a proportion of the member of the Boards of Management of the CNCA and the FNCA. The FNCA board also includes amongst its members Managing Directors from the Caisses Régionales, who have the same rights and decision-making powers as the elected Presidents in this particular case.

Finally, it is important to note the autonomy of each Caisse Régionale, particularly in the French context, where many large national organisations are tightly controlled from the centre. This is not the case with the Crédit Agricole: each Caisse Régionale has its own policy in a wide range of matters, enabling each to adjust its practice to local needs and conditions. The global equilibrium of the organisation as a whole depends on the balance of power maintained through the interplay between the Caisses Régionales (represented by the FNCA) and the Caisse Nationale (the CNCA).

2. THE TRAINING FUNCTION

The organisation of the training function, as one would expect, reflects the organisation of the Crédit Agricole as a whole. An important decision taken at the General Assembly of the Crédit Agricole in Strasbourg in 1978 placed the onus and responsibility for training of staff in the local offices squarely on the shoulders of the manager of each office ("tout cadre est formateur de son equipe"). This policy of devolution of responsibility ("demultiplication") is important because it puts each local branch in the position of a potential client or consumer with respect to the various training resources on offer, both from within and outside the Crédit Agricole. It is the task of the local office manager to draw up with his staff their own individual training programmes, dependent on their personal needs and those of the local office (see Annexe, doc 11). There is a generally accepted norm that up to 2% of the total working time available (summed over all staff in a given Caisse Régionale) can be devoted to training.

The Crédit Agricole's own training services and resources, which involve about 600 full-time staff altogether, are provided through two different channels. Firstly, the head office of each Caisse Régionale has a Training Department with a small number of full-time staff (a training manager and assistant, two or three secretarial staff, maybe a few animateurs). In some Caisses, the Training Department will also have at its disposal a certain number of specialists in particular topics drawn from local offices, or from the head office. These stafff have recieved guidance in training skills, and can act as trainers during, for example, workshops and other face to face training sessions organised by the Training Department. They act in this respect as 'raster practitioners', and will spend a small fraction of their time on training tasks with the prior agreement of their head of department or local office manager. In addition the marketing departments and the audio-visual department of each Caisse provide help in running training sessions at the Head offices. The full-time training staff at the head offices are generally people with prior experience of working as

managers or department heads in different parts of the Caisse Régionale. Although most have had some preparation in trainer skills, they are not typically career professionals in the training field, and may move to other management functions after a period of service in the Training Department.

The second element of the Crédit-Agricole's formal training provision comes from a central source - IFCAM: the Institut de Formation du Crédit Agricole. Based in the offices of the CNCA in Paris, this in-house training institute was established in 1976 through the merger of three existing central training organisations. Its Board of Directors contains an equal representation from members of the CNCA and the FNCA. IFCAM's annual budget is of the order of 50 million francs, about half of which comes from contributions from the Caisses Régionales in the form of payments for training services provided. Note that the Caisses Régionales are on the whole free to use other training organisations and consultants from outside the Crédit Agricole should they wish. In this respect IFCAM has to sell its services and balance its own budget almost as if it was an independent organisation. IFCAM currently employs about 70 full-time staff, and organises and runs around 25,000 man-days of face-to-face training each year, both nationally and for individual Caisses Régionales, in the fields of management, marketing, technical and general training, and audio-visual methods.

There are two specialist units within IFCAM which are of particular interest in the context of this study. The first of these is the Centre d'Enseignement Technique du Crédit Agricole (CETCA) which uses distance education methods to provide training leading to banking diplomas recognised by the Ministry of Education and the Ministry of Agriculture (see Annexe: doc 3a). The CETCA employs 10 full-time staff and about 500 part-time correspondence tutors, the majority of whom are employees of the Crédit Agricole (although some are drawn from other organisations). At the moment the methods used are essentially relatively classical correspondence courses, combined

with occasional group sessions of 2-3 days organised twice a year. But a study is currently being carried out to revise both the curriculum and the teaching methods. The CETCA was established in 1959 to help cope with the urgent training needs concomitant on the vast expansion of the Crédit Agricole's total staff numbers which started at that time (in the last 20 years, the total staff numbers have increased from about 10,000 to 70,000). This massive expansion was obtained through large-scale recruitment of staff from a mainly rural environment, necessitating fairly extensive training. Now that the challenge of turning the Crédit Agricole from a fairly small essentially agricultural bank into a large successful national bank with services similar to its competitors has been met, the CETCA's role is to be revised. Nevertheless, it receives about 7,000 enrolments each year for its correspondence courses, although the drop-out rate is relatively high. Current plans for revision of these courses include the possibility of using some CAL sequences, and the orientation of the curriculum towards the new challenges presented by the automation of so many of the traditional branch office functions.

The second specialist unit within IFCAM which is of particular interest is the department of Etudes et Réalisations Pédagogiques (ERP) which provides a range of services:

- research into training methods
- studies of particular training methods and programmes and of training needs
- development of new training methods
- training of trainers from the Caisses Régionales
- preparation of self-instructional training packages
- documentation and information facilities

It is this department which has been responsible for developing the use of computer-assisted learning methods in the Crédit Agricole, which to date is the main application of information technology in training which has been undertaken - successfully and on a significant

scale. The ERP is also, however, carrying out work on other areas related to information technology and training, notably:

- a study of the training implications of changes in working methods brought about by the installation of new information technology-based systems in the banks (automatic banking, home banking etc)
- a study of proposed changes in the distance education methods used by the CETCA
- a study of the possible applications of Videotex in training.

3. CAL AS A TRAINING TOOL

Origins of the Project

The decision to investigate the use of CAL for training of staff in local offices was taken by the Bank's central board of directors in December 1979, as one means of putting into operation the policy of local devolution of training, based where feasible on self-instructional methods. It is of interest to stress here that this initiative did not come from the Crédit Agricole's trainers in the Caisses Régionales or IFCAM, but from the management and staff.

The training needs were seen to be particularly acute in the field of informing and up-dating local office staff on the 100 or so new products and services developed and publicised by the Bank. These needs concern in particular the counter staff, who have to be able to answer queries posed by customers on a wide range of the Bank's services. And as the majority of the local branch offices are small, and in rural areas, it is not generally possible to have specialist staff available to deal with the more complex queries - each staff member needs to be relatively polyvalent.

The importance of training in this area should also be seen in the light of the Crédit Agricole's recent development into a bank "like the other banks" - in other words it is now competing with the other major high street banks for customers outside its traditional client group of small farmers and agriculturists.

Given the number (3,000) and dispersion (including overseas territories) of the local offices, and the cost and time factors involved in using conventional face-to-face training methods for such large numbers of staff, it was necessary to consider means which could be made available at the place of work, as and when training and information on specific services and products was seen to be required.

The project started with a small-scale experimental study in one Caisse Régionale (the Caisse Régionale de la Somme, the head office of which is in Amiens). IFCAM was commissioned to carry out this pilot study, through its department of Etudes et Réalisations Pédagogiques.

Basic Principles

The basic pedagogical principles adopted for the pilot phase and the subsequent expansion of the project had to be consistent with the overall training policy of the Crédit Agricole, namely that training is:

- voluntary and not imposed from above
- integrated with the job
- de-centralised, with responsibility at local branch level.

Given this policy, and the request to try out the use of CAL for on-the-job training, IFCAM defined the project as being one of.... "computer-assisted self instruction in the work place as a means of maintaining training, though the use of pedagogically varied dialogues" (1)

IFCAM place great importance on the 'pedogogical variety' of the CAL dialogues, and have made serious efforts to move away from the strait-jacket of traditional programmed instruction methods, and to give the trainee maximum control over learning sequences and strategies.

After initial discussions of the pros and cons of using terminals linked to a centrally controlled network, or independent microcomputers and discs, the latter option was chosen. The reasons given for

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(1) the form "dialogue" is used by IFCAM to denote a CAL sequence of 1½ hours average user time, recorded on a floppy disc.

this choice of an off-line system include:

- technical problems of interruptions and queuing in any on-line system
- difficulties in using the existing on-line work station terminals for training (different equipment in different Caisses Régionales, control of these systems by DP staff unsympathetic to training needs, over-riding priority of work needs over training functions etc)
- the autonomy of each Caisse Régionale would make a centrally-controlled on-line system dedicated to training needs politically unacceptable
- the local office staff, familiar with using terminals for their day-to-day work for the last ten year or so, might well object to their training being controlled by a central computer able to record and analyse their errors (this was described as the "anti-Big Brother" phenomenom).
- the importance of stressing that the CAL training option is a tool at the service of the local offices, and not a means of dictating their training
- the need for portability of the terminals - to be able to move them around both within and between local offices
- the need for easy up-dating of the CAL software.

After surveying the equipment and programming languages available in 1979, IFCAM opted for Control Data's Micro-Plato CD50, using Tutor, automatically translated to MICRO-TUTOR If the choice was being made now, in 1984, the IBM PC plus TUTOR would probably be the favourite . The reasons for this choice include not only ease of familiarisation with the machine, but also the pedagogical quality obtainable with this combination:

- the factors favouring a high degree of interactivity (rapid display function, variations in page lay-out, graphics and animation, user-friendly language, touch functions, and a wide range of possible question formats)

- good individualisation properties: ability to recognise a variety of correct and incorrect responses, sophisticated branching and feedback possibilities etc.
- the initiative remains with the user, who can control the learning sequence and strategy through, for example: calling up earlier screens, asking for help, asking for the exact response, referring to a glossary, changing the initial choice of sequence etc.

The Pilot Stage

An experimental try-out was carried out in two phases between November 1979 and September 1980, and from November 1980- September 1981 in the Caisse Régionale de la Somme, using four dialogues (on processing of cheques, 'bouncing' cheques, income tax calculations, and "the 5,000 F Law"). Each dialogue requires 1-3 hours of study time, and together the four dialogues cover skills of retention, application of rules of logic, and understanding of general economic concepts.

Three groups of staff were set up during the first phase, to measure differential learning gains using different treatments:

(i) a CAL group using the four PLATO dialogues
(ii) a group learning the same material through conventional face-to-face training seminars
(iii) a group which received no training at all, but which received the same test battery as the other two groups

Each group was of comparable size and matched for a number of key factors (age, sex, experience at the Bank, location etc). The measure of learning used was a gain between pre and post-test scores on questions relating to the four themes covered in the dialogues. The tests demonstrated that, other things being equal, the learning gains were slightly better for CAL than for conventional training, but that the speed of acquisition is twice as fast for CAL as for conventional training.

The staff members for whom CAL showed the greatest gains were men with commercial functions in small rural offices. The themes which were best learnt were those requiring some pre-existing knowledge (which coincides with later findings suggesting that CAL is not ideal for initial training of new staff). Finally, the study seemed to indicate that CAL was better than traditional methods for helping staff to deal efficiently with open-ended questions and problems.

The second pilot phase was a more qualitative study, involving interviews over a period of one year with 45 users and with the local office managers involved, mainly in the same Caisse Régionale. This time the use of CAL was under normal 'real life' conditions, under the control of the managers of the local offices amongst which the equipment and diskettes were circulated. The survey carried out was aimed at identifying the motivations of staff vis-à-vis CAL, and the optimal conditions for using the terminals and diskettes. Most of the users were attracted to the idea of using the micros (novelty value), and staff for whom face-to-face training was a nuisance (those who disliked group training, part-time staff, married women) were particularly keen on CAL. However, the usual reticences were also expressed vis-à-vis using computers: lack of personal identity, absence of personal contact, a fear that CAL might eventually completely replace traditional training sessions (especially from staff who welcomed the socialisation aspects of such training). Finally, the study demonstrated the over-riding importance of the attitude of the local office manager towards CAL. In offices where the manager actively promoted CAL, the motivations and attitudes of the staff were much more positive than in others where the manager was neutral or disinterested. In general, however, the office managers were on the whole more favourable to the introduction of CAL that their staff, and more open to innovation. Most of them immediately saw the advantages in terms of not losing staff days through face-to-face training, and being able to let staff train themselves on the spot in new or less well known products and services. As far as transfer of training to real-life problems was concerned, CAL was

seen as being more effective than traditional face-to-face seminars - CAL was able to bring together theory and practice in the work-place. Traditional training at the headquarters office was perceived as being more 'theoretical', and somewhat divorced from the practical problems faced in small rural offices. On the other hand, there are definite disadvantages associated with having the CAL terminal in the local office. The most serious one is that, unless a definite rota for use of the equipment is drawn up and adhered to, staff are liable to let the day-to-day demands of the job take priority, and to put off using the terminals. And when a staff member is using the terminal, he or she is liable to be interrupted by other staff and asked to retun to his/her desk or work station when a queue of customers forms, or when there is a pressing problem to resolve.

Despite those and some other reservations identified during the two-year pilot phase, the findings from this period were generally favourable, and it was decided to proceed with an expansion of the use of CAL to other interested Caisses Régionales.

Implementation, Organisation, and Costs

The way in which this expansion was organised reflects the "federal" structure of the Credit Agricole. IFCAM proposed the establishment of a CAL Community ("Communauté EAO") of those Caisses Régionales interested in using CAL. Entry into the Community involves each participating Caisse in two obligations in return for membership:

- to purchase from IFCAM 75% of the CAL dialogues availalable
- to provide to IFCAM, for a fee, one CAL dialogue on a jointly agreed topic each year

At the time of writing this report (Feb 1984) there are 30 Caisses Régionales in the Community, using 300 Plato terminals; 50 dialogues are currently available, another 20 or so are in preparation.

Each Caisse Regionale receives from IFCAM 25,000 FF (about £2,120 at current exchange rates) for each dialogue they prepare, and they purchase the dialogues they use from IFCAM at 4600 FF (about £390) each, for as many copies as they wish of each disc.

IFCAM provides a two-stage training programme, of six days in total, for authors of CAL dialogues. The first phase of the training is on the general principles of CAL, and is centred around six factors, namely the degrees of interactivity, individualisation, initiative, equilibrium, autonomy, and creativity, which a CAL sequence permits. The second phase of training is related specfically to the drafting, on standard proformas, of a CAL dialogue, and is in five parts:

- defining learning objectives
- organising content
- deciding on the learning strategy
- writing interactive units
- evaluation of one's work

A special manual is used as a basis for this training, and as a subsequent job-aid in authoring (see Annexe, doc 8). The authors themselves may be drawn from a Caisse's training department, or from one of its specialist technical or commercial departments. Occasionally, outside consultants have been used as authors.

The average time needed for preparation of one dialogue (average user time per dialogue being 1½-2hrs) breaks down as follows

- authoring: 20 man days
- content and pedagogical validation: 2-5 days
- programming: 10 days
- programming validation: 2 days

Particular care is taken at the pedagogical validation stage to ensure that each element of the dialogue is rated in terms of the degrees of interactivity, individualisation, and initiative which it presents. If below a certain norm, revision is required.

Programming is carried out by a small DP consultancy firm, using TUTOR and a connection with Control Data's CYBER computer in Toulouse. Technical problems encountered lie mainly at the point of automatic translation from TUTOR to MICRO-TUTOR.

Total cost of preparation of one dialogue works out at around 110,000 FF (about £9,300); this includes the 25,000 FF fee paid to the Caisse Régionale for the author's time. It is difficult to make a realistic estimate, however, of costs per hour of training time using CAL, because of the difficulty in collecting accurate data on the amount of time each terminal is used with the training discs in each local office. An estimate provided by IFCAM for a "typical" user Caisse with, say, 40 local offices, 400 staff using CAL, 12 micros amortised over 3 years, and an average user rate of 20 hours per trainee per year, works out at 31 FF (£2.60) per hour. This compares with an almost identical average per trainee hourly cost for face-to-face training at the Caisse headquarters, of 30 FF/hour. There has apparently been a noticeable drop in the length and frequency of face-to-face training sessions in the Caisses which are seriously using CAL.

The experience of the Caisse Régionale de la Somme demonstrates the importance of proper organisation of the use of the terminals if they are not to merely gather dust in the corner of an empty office. After a period of initial excitement, interest in CAL seemed to drop amongst many of the local offices in this Caisse. As a result, the Training Manager drew up a scheme which each local office manager can implement to derive the maximum benefit from the two-three month period that the terminal and set of dialogues is in each office. (In general, a Caisse is recommended to purchase one micro and one set of dialogues for every four local offices, and to leave the material in each office for a three month period). This scheme involves each office manager in drawing up a sort of "training contract" with each employee, which specifies, on a standard form, the amount of time each week he or she will spend, and on which dialogues. Norms are based on a proposed average minimum utilisation rate of one hour per week per staff member. The training

Department reserves the right to withdraw the equipment from a local office that does not meet these use norms

Experience so far seems to domonstrate that once employees have actively used and learnt from the CAL dialogues, and overcome any psychological or other resistance, the demand increases. This no doubt justifies using a fairly heavy hand in the first instance to persuade local offices to participate actively. So far, it is estimated that the total potential user population reached by CAL is around 10,000. This may well have increased by about 30% by the end of 1984, as it is expected that another 10 Caisses will join the current 30 in the "Community" by the end of the year.

4. LOOKING AHEAD

The use of CAL on independent micro-computers is likely to become more or less standard practice amongst a significant proporation of the Credit Agricole's Caisses Régionales. Other French banks have shown considerable interest in the Credit Agricole's initiative in this field:

- Société Générale use micro-Plato terminals on face-to-face training courses
- Banque Nationale de Paris, the Crédit Mutuel, and the Crédit du Nord , are following Crédit Agricole's example.

(Even English banks are showing an interest: in the week following my visit to IFCAM, they were due to receive a visitor from the National Westminster's Training Department).

At IFCAM, they are exploring the possibilities of developing the system in a number of directions in the future. Many of the Caisses Régionales are now buying IBM PC machines for their local branches, so it is possible that IFCAM will make discs available for these machines in addition to the micro-Plato. IFCAM are also interested in eventually promoting the use of the terminals for other purposes:

- local office record keeping
- word-processing
- customer information (using CAL dialogues)

In the broader information technology field, two developments are possible in the next few years at Credit Agricole. The first is the use of CAL dialogues as a component of the revised correspondence courses run by IFCAM. The second area of development lies in the eventual use of the TELETEL system for training and information provision in local offices.

MEETING ON THE FUTURE OF INFORMATION TECHNOLOGY IN EDUCATION AND TRAINING

16/17 April 1984, Brussels

PROGRAMME

Sunday 15 April

16:00 - 19:00 Registration - at Brussels Europa Hotel
19:30 Buffet Reception - at Brussels Europa Hotel (hosted by the Project Team)

Monday 16 April

9:00 - 9:30 Opening Address - and background to the project. The IT initiative of the CEE -
Mr.R.Huber - IT Task Force - CEC
Mr.A.Kirschberger - DG V

9:30 - 10:30 Session 1 : Socio-economic background to education and training in the 1980's & 1990's
Chairman : Dr Diana Laurillard.
Contributors :
Mr D Dolan, Dr A Gandolfi, Prof A Liosmeier, Mr W McDerment, Mr W Rasmussen

10:30 - 11:00 Coffee

11:00 - 11:30 Session 1 (Continued)

11:30 - 13:00 Session 2 : The role of IT-based systems in education and training
Chairman : Prof John Sparkes
Contributors : Dr S Baldassare, Dr J Breukker, Mr K O'Donovan, Dr F Gastkemper, Mr P Hansen, Mme A Radisse

13:00 - 14:30 Lunch

14:30 - 16:00 Session 3 : Existing IT-based systems and setting requirements for future ones
Chairman : Dr Paul Bacsich
Contributors : Dr B Camstra, Prof P Gorny, Mr O Holst, Mr B Lang, Prof Y le Corre

PROGRAMME

16:00 - 16:30	Coffee
16:30 - 17:30	Session 4 : Comparative costs of conventional and IT-based education and training Chairman : Dr Tony Bates Contributors : Dr J Akkermans, Dr C Curran, Mr M Jensen, Dr G Pangalos, Mr V Thompson

Tuesday 17 April

9:00 - 10:00	Session 5 - Future requirements, problems and obstacles Chairman : Dr Tim O'Shea Contributors : Dr S Cerri, Mr J Duke, Prof B Holmberg, Dr B Lavesen, Mr P Williams
10:00 - 10:30	Coffee
10:30 - 12:30	Working Group Session : Future projects (Short-term and long-term)
12:30 - 14:00	Lunch
14:00 - 16:00	Plenary Session : Reports from working groups. Chairman : Dr Peter Zorkoczy

Sessions 1 to 5 all follow the same format - prepared comments from the named contributors, lasting about 10 minutes each, followed by an open discussion.

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Prof Y le Corre	:	Universite de Paris 7
Mme A Radisse	:	Ministry of Education

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Prof P Gorny	:	Professor of Applied Informatics, University of Oldenburg
Prof B Holmberg	:	ZIFF, Fern Universitat, Hagen
Prof A Lipsmeier	:	Fern Universitat, Hagen

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Dr S Cerri	:	Informatics Department, University of Pisa
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PROJECT TEAM

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Prof John Sparkes	Professor of Electronics
Dr Peter Zorkoczy	Senior Lecturer, Electronics
Mr Maurice Geller	Research Consultant
Ms Carolyn Shaddick	Research Consultant
Mrs Susan Ayers	Project Secretary

0.1 Dr. Peter Zorkoczy (Project Director)

The theme of our meeting has been provided for us by the Commission who have asked our team to look at the opportunities for advanced educational technology in Europe. The opportunities, in particular for manufacturers, educationalists, people who have to make decisions about expenditure in education and training areas. When the team considered this problem we felt that it really breaks down into a number of areas that you have to consider individually. These were the areas that we felt we would like to present to you as questions, problems if you like, on which we would like to have your opinion. First question is, what are the challenges that society presents in education and training in the next ten to fifteen years and in particular in what ways can advanced educational technology help to respond to these questions? The second is, what are possible solutions .....? Lastly, and this is what brings us essentially here together today, is how can co-operation at a European level make the response more effective? As I said these are the questions that we have been grappling with as part of our Project over the last six months and now coming towards the end of the Project we felt it would be helpful in a situation which takes you away from your day to day pressures and which gives you the opportunity to consider these problems in a way that is conducive to creative thinking.

You will find that the first question breaks down further into a number of sub-questions, and these are the sub-questions around which we have organised the first day today. Obviously in order to try to get a handle on those questions we have to look at first of all what society is going to, what changes society is going to go through, what will be the changes in which those will be reflected on education and training, what are the cost considerations, how can one find whether educational information technology systems provide an answer to some of those challenges.

Now, it is also my sincere hope that this meeting will be the first of many which brings together a new European community, which is a community of educational information technologists, that is of people who are professionally involved in educational information technology. We have here today a very distinguished gathering of experts in the use of technological aids and electronic media in education and training, we have people from the academic and commercial worlds, education and training administrtors, independent consultants. We are asking you to consider some of the longer term strategic issues and also points of tactics, that is try to see if we can agree on some of the problems and some of the solutions which relate to the three areas. We also have with us officials of the Commission and our appreciation must go to them for initiating this study along with a number of other projects in this crucially important area of information technology and its application.

At this stage I would like to invite Mr. Roland Huber of the Information Technology and Telecommunications Task Force of the Commission, who has initiated this particular project, to tell us about its background and about the way in which our contribution, that is the contribution of all of us here fits in with the developments and initiatives that the Commission is undertaking in this area.

Mr. R. Huber

Ladies and Gentlemen, its a great pleasure to see you here and it speaks for the team working on this particular project that they succeeded to convince you to come to Brussels to discuss at the Commission, maybe even sometimes with the Commission, some of the problems which we believe to be common to the Member States. Let me emphasize that the problem is that of the Member States and not that of the Commission Services.

Let me look at it in a global sense saying what the problems are that we are confronted with in this context. Simple analysis shows that the qualified human resources, in economic terms, are a strategic asset. The point is, we are looking at the whole problem not in terms of either education and training nor in terms of information technology, but with respect to the overall economic contribution both of these domains necessarily have to make, and there the qualified human resources are a strategic asset of any industrial economy. Now if the figures I've had yesterday are correct the global spending of most member states of the order of about 7% of the GNP, which compares with about 5% for defence spending. So, quite apart from anything else we are talking about big business. Now you can ask, and of course our political friends will ask, what has changed, why should one suddenly be concerned about educational technology? Everything seems to go well, its storngly regionalised and everybody has a different concept and a different way of doing it. The reason why we belive we need to focus certain attention to the longer term aspects of it is that the demand in educational and training has increased and it has changed its characteristics somewhat. We have more variety than we had in the past, so standardised education and training becomes more limited and we have an increasing requirement for updating training because of the life cycles of particular training and skill have become partly very short indeed.

Now, that means that the costing has changed. Most Member States have severe problems to finance education and training, and strictly speaking they have a doubling of the demand if they were to take seriously the demand of industry and economy to update fairly regularly the education and training of their population. In addition, you've got a problem of inflexibility of traditional educational and training infrastructures. You have to drop out of your job in order to go to a university course, you have to do it wherever the university has the necessary staff and resources to do it, therefore this whole process is strongly inhibited. Industry would want to have education when required and training when required and not when offered.

Now, this translates into three things, increase in quality, increase in flexibility and increase in accessibility. In geographic terms it is no longer acceptable that people really have to go somewhere else in order to receive their instruction. If you look at the cost for satisfying this with traditional educational technology, it is very large indeed and under present circumstances nobody has got the cash nor the human resources to solve it with traditional means.

Now what opportunities does I.T. offer for part of the problem solutions? It can offer flexibility, it can do something about accessibility and it can offer economies of scale which are smaller than proportional increase. The challenge which poses itself is: can we exploit the potential of information technology for E.T.? If one wants to do so it is by no means a mean task; it would require massive effort, both in developing a teachware environment and it would require large scale and massive development effort in order to get low price, high performance hardware to go with it. I'm not talking about the things which you get now in the supermarket, I'm talking about work stations which are really up to advanced teaching.

There is a third category which one is automatically coming to and that is of course the teachware itself. The first two points, the development environment and the hardware may offer significant advantages of scale. The teachware itself I doubt can offer a significant advantage of scale. I'm not excluding it, but discussing it in a Community context - it doesn't seem to be an obvious candidate.

What is the point of the present exercise? We try to identify the opportunities for educational technology in I.T. and in terms of accelerating certain developments which are underway anyway. We are, and thats your particular objective, identifying specific design objectives. What is this going to be good for? The point is not that we want to have another nice report, we want to follow it up and this is why I'm indicating here the next steps which subject to the success of the first two phases will follow. It's a concertation with industry; it is obviously no good to have ideas unless they are translated; a design competition is more or less designing advanced educational technology systems on paper in a competitive environment and then making design recommendations and if all the other steps have been positive the identification and implementation of appropriate actions. This may sound a long way but there are necessary conditions for establishing concensus which then can translate into action. Thank you, Mr. Chairman, that is all I'm going to say at this moment.

Mr. B. Lang (Belgium)

Can I ask you one question here that I think it quite important? What timescale are we talking about for those four activities to be completed?

0.2 Mr. Huber

We are talking about the first two here, that is what we are in now, this subject to a positive outcome of these, positive, I mean tangible statements which one can discuss with industry. The concertation with industry would occur before June, and the design competition would occur in the second half of this year. It would be limited to three to four months and it would involve possible five to six man-year

effort in that period. Now it is the intention, subject to certain budgetry events, that competion would be 100% financed. We should have clear design recommendations by the end of the year, or early next year, which then would serve the basis for a recommendation and proposal going to the Commission and then to the Council. But all this is expectation and unless each step entails a concensus, of course, you cannot propose that in a Communicty environment.

Mr. B. Lang

Concensus of this group?

Mr. Huber

You are considered here at the moment as being a select sample, hopefully representative of a very much larger community of people concerned with educational technology. Hopefully, the diversity of views which we encounter in a bigger sample will be represented here around the table, so they are a kind of test bed for some of these ideas.

As for industry, the grouping is likely to be somewhere around 20 companies who are in this field, again we would work with what we consider reasonable samples of it, because you can't have dialogue with too large a number of people because our own staff resources are very limited. So if the ideas are able to get backed by a larger concensus then it is worth proposing and my colleague of DG5 who will say a few remarks in a moment, his main orientation is towards the content of education and training, while my objective is more industrial-technical. This means that we would have to have a fairly intensive consultation with Ministers of Education and partly with employment and partly industry that varies from one member state to the other. But none of this is going to yield anything unless the academics in this field and industry can agree on taking a common line. If they don't take a common line there is nothing to discuss with the ministers and we will propose nothing.

Chairman

Next I would like to invite Mr. Andre Kirchberger, who is from Directorate General 5 to speak, to tell us what other work is going on in this area and what in particular he is expecting out of our work. I know that he has initiated projects on the use of information technology in education on a number of occasions and I would be very grateful for his comments on how he sees our work in that context.

0.3 M.A.Kirchberger (CEC) (translation from the French)

It should'nt take very long, I don't think we've really come here to listen to the Commission anyway. I think what you here for is to have

discussions amongst yourselves about the report. All I want to do is explain to you the way these various actions and activities are complementary concerning innovation, R and D including training and education measures and this relates also to the connecting activities in social affairs section and concerning particularly the training education where I'm particularly concerned with training education in informatics.

For the last 2 or 3 years we've had various programmes under way, ESPRIT for one, R and D in particular and this I think indicates that the Community has become more and more aware of its position and this has lead the launching of a number of programmes. Firstly, the various legislative texts being prepared: the texts we have are two Resolutions adopted by the Council, one concerning vocational training in new information technology, the intention being to launch a Community programme for five years starting in 1983. The second resolution concerns the introduction of new information technology into education, that was adopted last June by the Council, and this enjoins the Commission to undertake a certain number of activities concerning training the educators and so forth - a programme dealing with the content of programmes for training in the use of the new technologies and this also brings about through the Commission a certain amount of work concerning teachware.

Recently, a few months ago in fact, the Commission sent a Communication to the Council concerning the subject of education in the new technologies, the effects this is going to have. This is being dealt with by the Ministers of Education. It is to be discussed in May at the Ministers of Education meeting and then at the beginning of June there is a discussion by the Employment Ministers, and all this leading to the Paris summit.

One of the discussions to be given to the social effects of technical change, including the effects on education and training. It is not my intention to describe the various activities, the various facets of various activities underway within the Commission on these two resolutions, however there is I think one point of convergence which is fairly clear between what Mr. Huber was saying and what I'm saying. This concerns the relationship between education in the general sense and industry in its broad sense. The point of convergence can be seen in these resolutions which say to the Commission that it should set up and develop methods for promoting co-operation between education and industry so as to develop appropriate structures which are most suitable to the needs.

This also I think relates to qualification profiles and education profiles which are changing nowadays in the light of the changing circumstances. I think education and training systems have to be able to respond to the challenges of these new circumstances. I see one or two familiar faces here today and I think as far as DG5 is concerned, which is a large organisation, what we are concerned with I think is industry really creating this better relationship between industry and

education. I think we're expecting a certain number of proposals, not of course proposals committing Member States. You are here as experts within the framework of a particular study and therefore we would like to have proposals which could help the Commission, the Task-Force or the DG5 or the Commission as a whole.

What we want are proposals which will help the Commission in some form or other to make proposals itself and to back up these proposals with a certain amount of activity which can cater for these converging needs, the needs of education and training and of industry. As to the timetables, these may be months or years. Where we stand at present within the Commission we have to cater for certain pressing needs, immediate needs which the education world has, the training world has and at the same time we have to look beyond the immediate future, as well as to try and plan for the longer term, look to the horizon. So I think your work is really to use a jargon word, going to be the interface between the short term requirements and the longer term. Thank you.

Question

My name is Stefano Cerri, from the University of Pisa. I would like to ask you two things. (A) what is the absolute value and the percentage of the efforts spent at your DG5 for what you said just now, namely information technologies into education or education into information technologies. (B) do you have any estimate of what happens in the member states, a figure abut what they spent and what is the percentage they spend into research and development and realisation of education in this field?

M. Kirchberger

I can give you some first values, some absolute values. I'm not absolutely clear as to what you mean by absolute values. Given our situation everyone will realise its a difficult question, unlimited of course but ..... it rather depends whether your talking about educational or professional training, the situation is going to vary from one to the other. As far as education is concerned we began very very small, minute scale in fact, but the important thing is to begin at least and then the budgetry authorities finally can be convinced that they should accept the idea in a budgetry context is is possible to start up new activities. To be perfectly frank its 100,000 ..... for 84, that is in the field of education ....,... thats direct access, for direct accress that amount. I don't want to talk about the budgetry context at this stage, but as far as professional training is concerned now the input is higher, the budgetry input because on the onehand there is a budgetry line actually called new technologies and professional training, 450 I think it is for that, there is also the social fund which does actually concern training, professional training this time, employment policy, labour policy and

so on, does have a lot more in the way of funds some of which are for experimental work innovation, demonstration work so all this would come under the social fund from member states, quite a lot of them require co-funding, co-financing by the fund. If I tell you its 85,000m part three, two or whatever it is of the fund then that doesn't mean anything because that provision is going to depend of course on the different requests made from the different member states, but I think as far as training is concerned and this will be the case in education quite a lot of funds are now going to be earmarked. Now what goes on the member states, I'll have to check and see if we can get some documents available for you. See if we have actually enough copies but it very much depends on the member state it varies considerably for at least one reason that it is very difficult to know what goes on in some member states and others its very easy to find out, easy in France or the UK. In both of those member states the strategies are centralised basically, as far as desemmination, circulation and so forth is concerned, even if the education system of course is completely different from one country to another, so in France and in the UK we can compile quite a bit of data on the number of micro-computers for example, in schoools, what is done in central administrations or through central administrations as well for teacher training. We can also identify fairly easlily what is done on the national level, what is financed in the way of R and D and in particular the introduction of new technologies and then on the other end of the scale from some member states it is very difficult indeed to get cenralised data, for example Germany because of the structure, the education structure is a very decentralised one, development is not homogeneous from one member state to another or one umpt to another or one lant to another and therefore it is very difficult to get it. Now in the case of Italy for example there is the same thing, you have this regionalisation in education development and the education system and again it simply that its more diffiuclt to get a hold of the data. We can get a hold of quite a lot of documents, they will be in French, English and German and they will of course be circulated to you if you are interested today or tomorrow.

SESSION 1 : Socio-economic background to E&T in the 1980's & 1990's

1.1 Mr.D. Dolan (Eire)

Good morning, Ladies and Gentleman, my name is Dudley Dolan, I come from Dublin in Ireland, I am on your list as coming from Beecom Ireland Ltd which is an independent software house and consultancy company. I also work as a Senior Lecturer in Trinity College, Dublin in the Department of Computer Science. I am here in my capacity as an independent consultant. As I was coming here and I realised the format I thought to myself that the very worst thing that could happen to you is that you will be asked to speak first, and Murphy's law prevailing here I am. The socio-economic background to education and training in the 1980s and 1990s, there is no mention of information technology there and I don't propose to talk about information technology in my small session, in fact to be frank with you I've come here really to listen rather than to talk so I will be quite brief.

I think it is important to address ourselves to what we are educating and training our people for, what sort of socio-economic conditions are going to pertain during what is left of the 1980s and into the 1990s, and indeed, what sort of hopes and aspirations will there be as we move into the 21st century which is right at the end of the 1990s. There are a couple of possibilities and I'd like to address them.

In some countries there is a feeling that there will be a permanent level of unemployment and we must gear our education and training to cope with the situation, perhaps with a move to arts and social services, educating and training our people in those areas, a move to leisure activities. If we don't take account of this and if we carry on eduating our people with hopes and aspirations for the future I think a certain number of things will happen. There wil be a level of frustration. In Ireland, unemployment is quite high at the moment and a level of frustration is creeping into the people in schools and universities, the realisation that they are attaining a skill and they will not be able to apply it because of a lack of opportunities. There are also false hopes, indeed the information technology business is one of the businesses that in some ways gives false hopes, because it is one brought to attention through the media and yet in some cases the jobs are not forthcoming in that area. And indeed, if we don't take account of the frustrations and the problems caused by false hopes we may end up with civil unrest. That is one scenario and it is possible that it may apply in a number of the EEC countries.

Another scenario is that there is a falling birth rate, in a number of countries the population is falling rather than rising. There rate predictions of a shortage of labour and a need for higher productivity, in which case what I was speaking about earlier will not occur and we will need to educate out people to cope with the change. This will mean, I feel, a broad education. Broad so that in an on-going way the population can be retrained at frequent intervals to cope with the change brought about by fast changing situation, led perhaps by the information technology business.

So basically we have different problems in different countries and just to illustrate, Ireland has a different problem perhaps than every other country. 50% of our population is under 25, a third of our population is under 15, which gives a twist to the education and training requirements which is probably not there within any of the other countries in Europe. In considering our approach to education and training I believe the Western world has got to give some thought to the enormous need for education in the Third World. I know we are talking now specifically about what happens in Europe, but perhaps what happens in Europe can be applied in the Third World, and perhaps Europe should be taking a lead in developing education and training techniques in the use of information technology which will ultimately address the education needs of the third world.

Just briefly, as I am coming near the end I would like to address the difference: we are talkng about education and training in the 1980s

and 1990s - my feeling at the moment is that within the context of Europe there is finance available and there are short term benefits from training. I feel perhaps that too much attention is being paid to training at this time, and certainly in Ireland the finances available for training but not for education. Training gives you short term benefits, there is the finance available, it is easy to see a return on the investment and perhaps since that is there we can use that as a research area for education. But surely, education is the area, not only becuase of my background in the university, but education is the area where we must invest in, and we must be going for a broad education so that people can adapt to change.

People must be flexible. It is an investment for the future and what will be required in the social context of the 1980s and 1990s is an equality of educational opportunity for all the citizens. I think we must address ourselves to balancing the expenditure between education and training. Education providing the broad base and training providing the situation for change which must be accepted. So, finally, education and training for what? I have not answered that question but I think there is a need for research to see what is going to happen, how many countries are going to be facing a permanent level of unemployment, how many countries are going to be short of labour? What is the overall situation going to be in Europe? I think policy decisions have got to be takne as to the direction of education, whether it is more towards the arts and social side rather than to science and technology, an attitude has got to be taken to the third world, what approach is going to be taken and a positive approach has got to come out becuase otherwise the students, people growing up will have this frustration and these false hopes. Unless a positive direction is put together by the Community I think the young people of today will lose direction.

Question

What does your company do in order to take initiatives in solving the problem in education and training?

Mr. Dolan

My company provides education, no my company provides training in data processing in specific technical areas. I am not, the company is not addressing the broader issue. We develop some of our own training material and we get other material from bodies in the UK.

Question

You are a service company for training to other companies. What do you think is the problem in changing educational systems, which is always a problem in adapting education to new requirements and therefore aiming it at the danger that you mentioned?

Mr. Dolan

I feel that the problem is one of over specialisation or a tendency to specialisation. I feel at the early stages education should be as broad as possible so the people are equipped and are not taught a particular skill, but are taught how to attain skills and therefore they can quickly respond to training. So I think one of the biggest problems is educating the educators themselves because I think the syllabus must be a flexible syllabus and in my country the question of changing a syllabus and a third level institute takes a long time and the Department of Education takes a long time to move. I feel we must educate the educators and the Department of Education toward that so we can get this flexible response.

1.2 Dr. Gandolfi (Italy) (Translation from the Italian)

I would like to give you my assessment of the impact of new information technologies on the educational system. In my view its not going to be so much the actual atmosphere of the environment, education environment that needs new solutions but the actual opposite so it is the development of micro-electronics that is going to be the important thing in the future, so that will determine new possibilities for the educational system. Now to micro-informatics. This is going to create new possibilities for education. In particular the development of micro-computers with large capacity, local capacity is going to make quite a considerable difference to the previous systems we had, video terminals and so on. There is also the question of personal computers. This is going to give us a low investment cost and nigh flexibility and also reliability, and its going to give us better possibilities for interaction with the pupils as well. What is being done should allow us to improve the performance form the point of view of pupils and teachers, most of all for the pupils and students. It will mean that their work will be more active and it will be easier to be able to follow the pupils in terms of rate of progress and actual causes as well and also the results for the more homogeneous. That was the pupils side, now for the teachers. These new methods, greater capacity, this will be very useful because it will mean that we'll have further possibilities in our educational system of different types. The phenomena of course very complex, simulation and such like will be made much easier. We will also be able to improve the possibilities of highlighting certain concepts and achieving educational objectives, for example things like problem solving and putting together models and also acquiring particularly complex concepts. This also means that we will be able of course to use video screens, tapes, cassettes and so forth, to have the whole complex really which will be of major advantage to all of us.

Now, on the new future possibilities, from a didactic point of view. Those who are actually managing the whole educational process, the teachers in other words, do have some problems as well. There is the question of programming and input, really using the methods correctly

and having the correct input. Of course, it depends on the type of education these methods are being used more and more and so micro-processors will be able to be used in the next few years and I am talking here on the next five or ten years so that we are going to be using micro-processors, computers up to about 10-20% of the actual time of education will be devoted to this. We could even get up to 100% when we have an educational system based on telematics, using televisions and such like for teaching at a distance. That means that you can actually transfer two computers, different actions, mass education actions, to great advantage. Now what about the hypotheses, what can we do in the short term and medium term that is the next three and four years in terms of educational structures and to make sure that the schools and so on will have two sorts of environments, This is talking in terms of another 800 to 1000 pupils, so you are going to have your large groups of pupils and also of course used in smaller groups. Now lets look at the longer term implications of this. Obviously it is clear now that these methods will be used with a certain system really of administration, it will be three levels that will be involved. First of all computers which will be connected to local networks so that the normal graphic data processing functions will be assured and also a link to a processor of a higher level and this is to manage programme, to distribute data programmes and so forth for working points really and will be able to ensure the full vanishment of the data processing programmes via the local networks. The third level, that is the creation of local networks, institutes, geographically placed centres, data basework, management of data bases and administrative data. The fourth level of the development of the system is the integration of the systems into large national networks, that is to say data distribution areas. Therefore as a product of this trend you will have a major integration between the training, teaching systems and the centres such as universities, research places as well, those who produce software and data base centres, plus public and private services of distribution of software and data distribution.

What I've tried to do here is to put down the development layout of this, a category if you like in an educational system. This is really the link within an institution, school or whatever, there is the administration part, the actual teaching administrative part and its links with the other points and this is the overall layout between the different educational groups really, areas. The management system of data courseware, administrative data, institutional data and so forth and then the national network for data transmission and educational software, that will certainly be developing over the next few years. Now this aspect is particularly important because the further development of these things over the next few years will be setting up of major distribution networks, networks for software, on telephone lines and through the television distribution network, even more software transmitted using distribution channels, television basically. Several quantities of data information and these are actually services which are beginning already, teletext services, they will be used to transmit data and to organise major national software distribution

networks. These will certainly be used for national projects, plans and distribution of software.

Well as I've already said this is all going to change the role of the teacher very much within the system. So the fundamental problem will not be so much that of guaranteeing the indepth knowledge of language or technology and so on, but rather preparation for the teachers so that they can actually understand implications and really use fully the potential given by these methods in the field of teaching. Only teaching non-scholastically training systems, non-institutionalised ones, things will be a little different for training actions at a distance, for mass training or intensive courses, those organisations concerned with this type of training are bound to be moving in a certain direction, setting up central headquarters point of centres for working out courseware, lessonware, using high potential mini computers which will allow for large production of courseware in very short times. These will have video terminals for the staff who are to prepare for further education or to work on the actual educational software. Now in these headquarters really where these are going to be used there will be certain working areas with floppy discs for individualised study work.

Obviously in systems of this sort there will be this sort of system, in other words between the centre where you produce the software using a mini computer with a particularly high potential system and then the sort of marginal areas where the actual course work is going to be used in other words. Those are the two levels and it will depend on the activity and the dimensions here, you can also have links which will also pass the software through the telephone or whatever, it will depend of course on the overall dimensions of the activity and an estimate of the cost benefit. Advantages or otherwise as I said different systems will be used including telephone. One final point, the trends here over the next few years using microprocessors of course 64 K bites. We are moving towards 64 minimum that is the likely memory that is the future trend at any rate for these systems, that of course separate from the actual software, the display unit and so on, then the external memories of the floppy discs, also then your going to have a system up to about 5 mega bites 10. We'll be able to have a link with at least 30 stations, one mega bite per second will be the rate and then for a system which will be linked to local networks the trend will almost certainly be towards unix type systems and other things as you can see, this is the display side now, 640 and 400 and so on. There will also be more specific requests coming in, possibilities for on lying links and special interfaces, TV adapters and so forth and codifiers, for the television links. Then finally interfaces with video discs and video tapes for the management of the different educational systems. Thank you very much indeed, if there are any questions I'll be happy to answer.

Question

You seem to have given a very optimistic picture of the use of micro computers. Do you think that education and training is really a matter of dialogue between presons who are teacing and those who are learning? And then another question, you do have major hopes for the use of personal computers and the extension thereof, but when we talked about programme teaching this is what we were thinking of about 15 years ago. Do you have the same sort of view of the situation now?

Answer

Well using microprocessors will allow for an integration that is what I said, a greater integration in the next few years between teachers and pupils. To come on to your second question. A microcomputer will allow us to do things that computer aided instruction would not allow. It will mean we can take things a step further, actually using computers in the field of education. Teaching of the traditional type is only one part of the whole package of possibilities we are going to have in the future using computers because computer aided teaching of the traditional type was rather too rigid, it gives you a certain but limited degree of inter activity. You can't do things like simulation and problem solving of a more complex nature except in special cases and the micro computer with the right software will mean that you can go much further, you will be able to tackle other areas for using the computer and in the past these things were not possible as I said before. For example simulation of certain dynamic phenomena using techniques of the traditional type could be done but only in special cases before and this will allow for greater possibilities.

1.3 Professor Lipsmeyer (Germany) (Translated from the German)

I am concerned with research into problems in vocational training and further training. We are concerned with the reaction of educational system to change in the light of technological change, the concept of continuous training. We now have to consider the problems of continuous training and assess its significance to people and society. This may seem to you to be superflous or even ironic. Superfluous becuase you might think that its already quite generally accepted that we need to have continuous trianing. You may think its ironic because the promises of continuous training given the prospects of unemployment you might think it was pretty well pointless to have continuous training. The end of the age of continuous growth has lead to many changes in attitudes, what are the most important features of the new circumstances we live in, what features are most important for vocational training and particularly for life time training? I would like to restrict myself to what I think are the important aspects.

First, there is the demographic structure which is changing in our various countries. The older portion of our population is going to continue growing for a number of decades to come given the fall in the birth rate and longevity. Also the reduction in the total working

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life of people which gives greater time for leisure, also non work activities are becoming more and more important for people. There is also the technological changes and the economic crisis, these factors would probably lead to growing unemployment in the Western European countries. Technical progress has lead to great changes in the different types of qualifications needed and lead to enormous structural and regional changes in the economies of our countries. Occupations and jobs have a great deal of importance in our industrial societies given the time that they take up. Now many peoples attitudes are changing towards their jobs so that the concept of the job is losing to some extent its importance.

We are only going to change our concept of education, our traditional concepts of education in Europe will have to change, we have varoius different attitudes within our countries and its probably going to be difficult to bring about a concensus in Europe about what we think is an educated person, its probably more difficult to define any more. There is also a change in consumer and environmentalist attitudes which is affecting more and more people. The life styles of people now are differentiating themselves more and more and changing more quickly than they ever did before. There is less drive towards material success particularly in young people nowadays and gradually there is a certain weakening of the work ethic which might to some extent bring about a change in the traditional capitalistic attitudes. This is an incomplete list of course, you might say some of these are only temporary phenomena but at least these are matters which ought to be considered although we can't consider these factors in any great detail because we don't have enough time. In the FRG a number of measures have been adopted concerning the new technologies, if I could just mention five groups of activities. Modernisation of training standards with a view to take into account automation, micro-technology and so forth, secondly more and more courses are being offered in micro-electornics both in factory training and educational courses. More and more posts, more and more places are being offered for vocational training which are equipped with hardware and software with computers, text processors, CAD equpment, more in the use of computer aided manufacturing equipment which are now being used for demonstration purposes in eucation, there is more and more use of various types of media for the distribution of the new technologies, a use of televisions, we have the further training of educators where we have another programme which I'm particularly concerned with which I don't have enough time to talk about.

Then a few final comments: micro-electronics are playing a central role in the present discussions concerning social and economic changes. This technology is allocated a key role instilling a new dimension on the concept of technological change. For the first time, since the industrial revolution of the last 200 years, technology is now spreading its effect well beyond the economy of the factories to services as well and also directly, not only indirectly, into the private lives of many many people which is something the prior industrial revolution didn't do. There are a number of politi-

cal differences of opinion which represents difference of opinion on the structural implications for education and trianirg measures have been adopted in many countries, not only in Germany. Adult training, in particular further training, is particularly affected to differing degrees. In general, further training should be a question of addressing large population groups so as to make them familiar with the use and applications of these new technologies. Furthermore, it is important to see education as a way of enlightening people in the implications of this type of technology so as to explain what the effects are on the employment market and to explain the effects which the new technologies will have on job content. It is only on the basis of education and enlightenment that we shall be able to have people who understand, workers who understand what is intended and I hope that this will mean also that people will be able to make their own decisions, however there are conservative trends which are deeply rooted in many of our educational systems within Europe. Thank you.

1.4 Mr. W. McDerment (CEDEFOP, Berlin)

The Centre in Berlin, the European Centre for the Development of Vocational Training, is interested in very practical approaches to the question of training and adult education, and I have been working for the past four years now on what we loosely call new technology. First of all, I would like to say that the opening speaker who wrote his contribution sitting in his office in Brussels, and this present speaker who wrote his small contribution in an office in Berlin, have written virtually identical papers which could be a good sign or could be a very bad sign.

I want to go back to what our Irish colleague said about a strategic investment in education. I think that is an extremely important point that is coming over from the work that we are doing, the need to see investment in educational training, particularly to deal with new technologies in manufacturing and in service sectors as a strategic investment both in the individual and in the National economy and not, as is too often the case, a cost that people don't really want to face up to. Coming down to a ver practical level, we conducted a number of interviews in 44 companies in three countries, two or three years ago and we are looking at the introduction adn the management of technological innovation in industry and also in the service sector. The results of those interviews were quite frightening really, because the researchers came to the conclusion that training needs existed on a massive scale at all levels in industry and in commerce and that these needs were not being met by the traditional education and training provisions.

I was in one very large motor manufacturing company last year and the first complaint I got from the senior training officer was the basic education level of the maintenance personnel was so poor that they had to bring in teachers to give them basic education courses in mathematics before they could follow the instructions for the introduction of

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150 robots and a more or less completely automated assembly plant. This had been the biggest problem for them, and the first time in fact, that the serious basic education deficiences of an important sector of the labour force had been exposed by the introduction of new technology. Going back to the schools, we have a situation in Europe where a lot of money is being spent on the introduction of computers in schools, but we find if we look more closely at the situation that many of the children have something less than 10 hours a year exposure to these computers. I can give you one example where we had a contact from a school and they proudly announced they were going to buy five computers and then about three months later sent a letter to all the parents saying, do any of the parents kow anything about computer programming. So, it is all right buying the hardware but we also need the teacher, and that applies to industry as well, and so I'm saying here basically that training in the new technologies and the use of the new technologies should be seen as an investment. The traditional approaches are not going to keep pace with the rapidly changing demands of new technology.

The other point I want to make is that we're not only having problems in Europe. I was in the United States last year, looking at the question of new technology and the management of information technology and new technologies in manufacturing. I was told there that the so-called high technology companies in Silicon Valley and in the 128 area around Boston are increasingly disenchanted wiht the education and training facilities provided by local authorities and institutions and are increasingly thrown back on their own resources. I was told that this was the only way they could reamin competitive. These people are using the new technology themselves in distance learning to branch factories and laboratories and so on and investing considerable sums of money in this. Going into MIT and to other Universities in the Boston area, I was told that they could not keep up to date with the demand, to meet the demand for courses on high technology. Firms were being increasingly cast back on to using new information technology in teaching situations to overflow classes on the premises and to satellite training establishments in other parts of the state. They told me there that at Standford a lot of their post-graduate students are taught by distance learning systems and that this was the only way they could keep up with the demand. I was also told at MIT that new technology is advancing so rapidly that they consider their first graduates to be out of date anything to between three and five years after they graduate. This business of constant up-dating and constant re-qualification for working with new technologies was a theme in all the interviews I had.

Now, it is quite obvious that the traditional classroom educational and training facilities have no chance whatever in keeping up with this rapidly developng and changing situation. I think here it is important to look at the basic educational foundation. I think this is going to be something that's going to be an extremely important investment. Basic educational foundation on which training and re-training can be built at very frequent and probably increasingly frequent intervals during the person's working life.

On the question of introducing new technologies and particularly my field of interest which is in robotics and in manufacturing equipment, it is not only important to train people who will operate the machines, one of the most important training needs and on in which the Americans are concentrating to a very large extent is on engineers, design engineers and high-level, graduate level technicians, these are the people who will make the greatest contribution to the exploitation, development of exploitation of new technology on which the European Community countries and Americans and Japanese are putting so much hope. On the question of getting new curricula, in Japan, for instance, I was told that it takes up to four years to get a new curriculum organised and approved by the Ministry of Education and then presented into the colleges. So again, in the case of Japan, they are increasingly dependent on their own training activities within the high technology companies and in fact, one speaker said, in Japan, despite our enormous success in new technologies, education and industry exist in two different worlds. I think here we have, if we're looking at new technologies in terms of competition with Japan and America some quite interesting lessons - we're not the only ones who feel that the traditional education and training facilities are not able to keep up with the demand.

The period between invention, discovery and a wide application is also valid in this area. Even if it would be 25 years or another period we then have the problem: when do we start counting in the case of information technology? Is it the first micro-based computer or is it the discovery of the transistor or integrated circuit? The second uncertainty is about the nature of this technological progress and of the product which will be resulting, and here I think in particular of the whole area of man-machine interface, the fifth generation computers and so on. There are many people who belive and there is obviously some evidence for it, that once this technology is wide-spread and applied the present programming languages will be completely obsolete. Yet on the other hand we know that traditional programming languages, such as BASIC or Fortran - COBOL and so on, are being used for quite a long time, although scientifically speaking they are by now depasse. Now, that might, of course, change it might change but it might not we don't know enough about that.

Then there is our uncertainty about the impact of information technologies on employment - short run and long run - and about as I have already said about the structure of qualifications. Will there be a deficit or will there be additional jobs created in the long run? That is linked to one of the points which you Mr. Chairman made, how useful, how effective is it to train the unemployed in this area. There seems to be some experience, in particular in France, Marseilles, where quite a lot has been done. Can this be generalised? Obviously it is linked to the overall question of balance between jobs lost and jobs created, because you can train some unemployed but that might mean also that other people will get unemployed instead of them.

Fourthly, and this is probably the most difficult one, the uncertainty about the social inter-actions which are generated by the spread of

new information technologies. We know very little about the resistance or support which are raised by this development. Often we neglect them or we ignore them, although they might be the decisive factor as far as the speed of the diffusion of the new technologies, especially in education are concerned.

Fifthly and finally on my list, the whole problem of the third-world countries which you also mentioned. There are some people who believe that the spread and allotment of new information technologies and education can help the developing countries to catch up. But there are others who argue that the danger is exactly the opposite, that the industrialised countries will become, or the rich countries will become, even richer and that the gap will widen.

Well, each of you could probably quote and name other uncertainties. Now how can we reduce the uncertainties, because I believe that to reduce these uncertainties is one of the conditions of - one of the prerequisites of co-ordinated development. Well, just research, more research into these questions, more pilot experiments in these areas, evaluation of these pilot experiments, and the like, and of course even all those if they are fully applied, still will not get rid of all the uncertainties. The only solution then, or the only strategy then which remains is, what you might call in very general terms is flexibility. Flexibility in our policies, in our policies adopted, in the strategy envisaged.

Now, just one word, there are of course some certainties or at least some probabilities, high probabilities. Well, one of them is quite clearly that the use of information technologies in education and in jobs will not necessarily make these jobs or the education process simpler. On the contrary, most probably or most certainly use of new information technologies makes people more able to handle complexity. Now what exactly that means for education is of course another matter, but I would believe that this is probably the key question of the whole thing, because the educational requirements in a sense, become much bigger. The second point, who should be trained as a priority? Well, obviously all surveys show that there is a great deficit between theneeds of the computer industry or of software producers and so on, and the educational capacities, timing capacities of our systems. Yet I believe that these needs as regards top level specialists are concerned or specialists in new information technology, are not quite out of proportion, but I'm not sure. If you look at figures, the UK or in France, if it is 2,000, 3,000, 4,000, 6.000 per year, it is not out of proportion. Where the problem beocmes much bigger is probably in the training of other people or, if you want, finding other specialists, people who remain specialists of their respective field, whether its chemistry or business management, providing them with the necessary and appropriate IT or new IT dimension. There obviously the needs are not in thousands but in hundreds of thousands, or certainly in tens of thousands, even in smaller countries.

So it seems to me that the real challenge which is faced, which educational and training systems of European countries are facing is this

provision of the IT dimension in, if not all, most of the fields for which schools, training institutions have to prepare. Now the last and final word - strategies: I think there is one strategy which has been mentioned several times and which has probably to be looked at in a new light, and that's continuing education. We speak about continuing education since 20 years but proably not enought has been done. It might very well be that with the IT available, continuing education can be see in a new perspective and may be a more effective perspective. The second strategy seems to me a kind of new link or more of a closer link betwen educational and training institutions and indudstry. I think this is one of the key strategies in general and may be with regard to IT in particular. Recently and this is my last word, I have been at a conference in the UK on training within industry and one of the American participants at this conference was saying that when a new image in the United States and the history of the united States has arisen, the only solution was to create new institutions to meet it. In 1981, when modernisation of agriculture was the biggest priority land-grant colleges were created. When general education, when private and secondary education became universal, a new network of teacher-training colleges had to be created, and when in the 20th century the needs of equalisation of educational opportunity, the link with the community have arisen, community colleges had to be created. I don't know, I ask this as a question, I put to you, is this also true as much in Europe as it seems to be the case, according to him, in the United States? Well, he said that-nowadays the need for adpating training and education to the needs of the economy and of the industry already leads, and more and more will lead to the creation of specific trianing schemes, if not training institutions. Within industry and indeed in the United States you already have some industries which offer doctorates or Master degrees which are fully licensed. Well, I don't know if this will happen in Europe but certainly it is a point which one might reflect on. Thank you.

Question by Mr. Steffano Cerri (Italy)

When you suggest all these interventions, all these impacts of information technology of education at several levels could you suggest also a clear definition of the percentage of resources by your organisation which could be eventually spent and which your organisation should be advised to spend, to solve all these problems. Could you transform your advice which comes from an international organisation, European organisation, into an official suggestion in a form of perfentage of resources given to solve the problems?

Answer by Mr. W. McDerment

I know its a very difficult question, but I am not in an organisation which is financed by Government. It is an organisation whose whole

budget is devoted to - my part of it is devoted to education, so its 100%. I don't think there are figures. I think that all the people who tried to evaluate how much this and this will cost are running into difficulties because the calculations are so difficult. You never know what you should include, what you should not include - you can't produce the figures exactly.

Question

Although yourself and Mr. Dolan spoke of the need for strategic investment in basic education we also have the paradox of high unemployment and shortage of labour in certain areas. The question is do you have any indications or do you know of any reports that indicate what the manpower requirements willbe throughout Europe for the kind of training that companies are looking for in this area, and is it necessary for all people to be trained to those levels, given the fact that a lot of people are going to be unemployed? What is the balance basically between high training needs and employment levels?

Mr. McDerment

I think first of all everyone should have a good basic understanding, one of the things we have found has been the need to raise the general awareness and knowledge level of New Technology in general for everybody and I don't think we can afford a situation where we have one group that's technologically illiterate but I will come back to this.

It is an interesting point you have raised. When I was in the States I spoke to some people at MIT about just this question what is going to happen to the ones who will either not have final employment in manufacturing or the teritiary sector or who are in it now or will lose their jobs because of increasing levels of automation and they said this was a subject that had not been addressed in the United States to any serious extent but was one that was really exercising quite a number of the academics who in fact felt that there would be increasingly high levels of unemployment in the States as a permanent feature and that the big question in the future was not going to be who to work with new technology or how do we train people to work with new technology, the big question was going to be what kind of educational training do we give those who will not have an opportunity to work with these technologies, and if we have a situation where we have a polorisation of the population into technologically literate and technologically elite if you like, we are going to have serious social problems in the longer run. So far as I know, going back to the question of a demand for personnel in this field I have no idea, I haven't seen anything so far that has made a serious attempt certainly not on the community scale, I know of studies done in Scotland for instance, where they have done quite an interesting manpower survey on needs for New Technology, but the few I have seen were fairly local studies.

Question

My question was rather similar, I was wondering whether you have any comments on any other fields of engineering, whether you suggesting that there should be a general education and then 'topped up' many times during your career is thought to apply to other fields of engineering or to other fields of vocational work, because the boom in jobs in information technology at the moment might actually be replaced by another boom in 10 years.

Mr. McDerment

The main reason for the study visit was to look at robotics at a very large exhibition and conference in Chicago last year, with an opportunity to seem something like 220 robots operating at the exhibition which would have taken me an awful long time to have seen in individual factories, and also to talk to people who were working on possible development there, so I was basically looking at what was going to happen there. One interesting comment that came up from a very large manufacturer was, if the educational training organisations in Europe do not make the effort to provide people with the right knd of skills, our response to that will be, we will make our robots and other automated manufacturing equipment as fool-proof as possible, in other words we will probably have scredriver factories in Europe and all inventive and development work will be done in Detriot or in Silicon Valley or whatever, or in Tokyo, but it certainly wouldn't be

done in Europe. They would be looking for an increasingly lower level of general competance in factories where they would be buying imported equipment. I think that is something we have to be very much aware of. I know I spoke to someone who came from Greece recently and they have exactly the same problem. To some extent the problem exists in Scotland and Ireland where high technology companies have been attracted in large numbers, but if you analyse the impact this had had on the demand for more highly skilled personnel you will see it is not very encouraging.

1.5 Mr. W. Rasmussen (Denmark)

Well, Ladies and gentlemen, it is a great pleasure for me to have this opportunity to ask for your help, not for me particularly but for the World Community, so I am coming here to utilise this opportunity to stimulate your aid to the World Community. Those who have the opportunity to read my paper, which is the first in the package will know what I am talking about, because the paper explains about the International Bureau of Education which is located in Geneva and which is located in a beautiful surrounding, beautiful in more than one sense because it is also beautiful in the vision which you get. It is a kind of International Village to the advantage of and for other progress in mankind, it is located now in the neighbourhood of the International Labour Organisation and the World Health Organisation and other Organisations. In this International Village the International Organisation and other Organisations. In this International Village the International Bureau of Education was set up a long time ago to function for comparative education, which means that here is a centre originally designed in this idea to serve every country in the World. It was great thinkers like Piaget who were inspiring it, and it happened already in '29, long before UNESCO set up. UNESCO was set up after World War II, but UNESCO did accept the financial responsibility and there was a treaty between IBE and UNESCO and now you should regard IBE as one of the arms or legs or heads of UNESCO which also has other centres spread over the world like the CIPAS in RUmania, like the Institute in Hamburg. There is another Institute for Educational Planning in Paris and then there are regional centres around the world, about 5 or 6, one of them that has impressed me by its work and its vision is located in Bangkok - the Asian programme for educational innovation for development has its headquarters there. In fact this International Bureau of Education is governed by small selection of countries which alternate and in my paper you can see which are in the Council at present.

I have the privilege of being a representative of Scandinavian and Northern European Countries in this Council. At a very recent meeting in February this year, I was meeting for the first time the new director Professor Cess Spalding who is an American, who 10 years ago worked within the UNESCO headquarters and at that time had the vision of setting up the Asian programme. He has just revisited Asia; I haven't had the opportunity to hear about that trip, but I am sure he

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has been met with great appreciation because he is a very competant person. During that meeting in February I was participating in the discussion and I was grasping one of the new directors ideas, which was to have a higher involvement of new type technolgoy to the benefit of this documentation centre in Geneva to use really well functioning database technology and use well functioning distribution of the communication from the documentation centre when any country or institution in any country would ask for the documentation services.

This you can find in the paper I have made a resume of what I have said on that occasion. I also made reference to a recent development in UNESCO itself, the European-American project on application of new technology, the so called giant UNESCO project, UNESCO 11 in which several countries participate. I have made a list of what countries are participating in that project. I also made reference to a programme which at this point is empty, it is only set up as a cover to ensure that nobody else is taking over that challenge of finding out how to make informatics and new technology available to the whole world. The Director General, who is from Senegal, Mr Amadu Matu Amdal, thought it was wise to set up this committee, but no money has been allocated, no action has yet taken place, but the idea is sound and good and can be put into action. This is what I would call the global challenges which are facing us so this response exactly to the programme for this 2 day meeting.

We are in fact able to read about this challenge in book Le De where he maybe a little optimistically saying that the new technology may solve the problems of the Third World, but at any rate we should be able and here I now turn to the conclusions and proposals in my paper. We should be able to give real good help by establishing database in Geneva in co-operation with other databases. Since I was in Geneva I discovered a recent publication by UNESCO who made a survey of how many such databases exist and what is the software and hardware involved by questionnaires very well designed. 600 centres were approaches and 188 responded so significantly that they were included in this directory. I would be pleased to give indications of the name of this marvellous directory. I discovered only one Danish centre incorporated any by a recent visit to the Danish centre for experiment with databases I found that there are 50 only in Denmark of which only one was incorporated, so my estimate is that there are close to 1,000 well functioning databases.

Mr. J. Duke (UK)

I would just like to make a comment on what I see as perhaps needs and requirements for education in the future, very briefly. Current profile of educational attainment, in terms of the numbers of population who are being educated might be roughly represented by this, few who are well endowed with educational abilities at the end of their educational careers, large proportion of the population - not well endowed. This translates over in fact to industrial demand for labour in our

sort of traditional industrial pattern, few in the professional policy making areas rather more perhaps in central and middle management and supervision, large numbers traditionally in operative jobs and unskilled jobs, that pattern is changing very rapidly indeed as a result of the developments in technology, and is moving more to a pattern illustrated by the green-line where there are rapid decreases in fact in the number of skilled and operative jobs. Massive change in the sort of middle sector in the types of jobs that are being required of people in management and relatively more jobs being created in skilled highly professional areas and as was suggested earlier, actual shortages of labour in many highly technological areas. Now these are quantitative changes and have to obviously be reflected back again into the type of educational profiles in fact perhaps that we must expect of people in the future, but apart from these quantitative changes there are qualitative changes as well, because we are moving very rapidly away from manufacturing operations. In fact the UK balance of payments in manufacturing has now gone right into the red and will stay there forever. Moving into service-type activities and moving on even further into information based activities, so here are 2 types of change which are going to occur, which are occurring already, the evidence is already there. The profiles in fact of the type of employment and the types of careers in fact, that are going to be expected of people is already rapidly changing, and that has to be reflected back onto the types of education experience you give people and again the nature of the tasks themselves are moving away from industrial manufacturing more into service type industries and even more into information bases industries. Thank you.

Question

Is it an empirical hope or is it your hope for the new technology?

My knowledge in qualifications, to the extent that there are empirical do not really confirm your green curve, I think what they do confirm is a great deal of uncertainty about development in qualifications, whether we are going toward higher qualifications or de-qualifications. As to your optimism on the future that is to the green curves, I must admit I can't share that optimism, at least not according to the empirical studies carried out so far, so, this is empirical what you are talking about in these curves or is it just what you are hoping for.

Mr. J. Duke

Empirical in the sense that it is more speculative, I suspect. It is a view I am taking of the future, which is predicted in fact on the way in which technology will infiltrate our commercial and industrial activities, the way that robotics and automative processes in fact will move into manufacturing industry, the way that these techniques will also move into office and administrative activities of one sort

and another, which again are going to cause changes in the ways that organisations are structured and the way that work is structured and these again as I say make both quantative effects on both the numbers of different types of people who are going to be employed in different types of jobs have to be carried out and the types of skill and the relationships between management and employees is as I say is going to bring qualitative effects which again have to be reflected in the educational background of the people employed and the actual training they have to carry out those types of work.

Question

To pursue this matter, now of course I hope you are right I hope your hopes will be fulfilled, but the facts as we have them so far already speak against your assumption. Taking an example, which stands for many other possible examples concerning machine tool trades, the same applies to other areas, thats a very quantatively large area. During the next few years we should have CNC machines being used and the qualification level may move in the direction of your green curve thats a transitional face in as micro-electronics full machine tolls increases and for the machine tool trades, then there will be centralisation of functions, and then de-qualification of those who operate machine tools and similar and so for that area machine tools, your green curve might be acceptable for the next 5 or 10 years, but I wouldn't see it as a forecast of the trends for the longer term concerning the effects of new technology. Thank you.

Mr. McDerment

Just a comment on that, on what Dr. Lipsmeier's been saying, it presupposes the existance of some kind of technological determinism that will have an inevitable effect on the qualification level demanded of the labour force. Our work has shown so far that technological determinism does exist to a certain extent, but it does not determine the way the labour force if organised to use that technology. This is entirely a question of company policy, the company can either say we will buy the latest technology then we will have idiots to push the buttons and one man actually said that to me, or we will reorganise the work and we will go for a job in Richmond programme, in which case then we will put a great effort into raising the general skill level, qualification level of the labour force. My personal view on that is that this is only an interim face that in fact the technology does have a form od determinism built-in to it and that as Dr. Lipsmeier said, once people go further along the road to computer integrated manufacturing the scope for making decision whether to increase the general skill level on the labour force or to reduce it in order to get maximum economic benefit and productivity gains from the machinery will eventually force, in my view, a trend in the direction of de-skilling and de-qualification.

Question

Could I just ask, I accept de-skilling and de-qualification, but in terms of total numbers employed in these tasks are you still suggesting that the pattern will be similar to the traditional pattern i.e. relatively more people employed in de-skilled jobs than in more highly trained tasks.

Answer

My contention is that the pattern will tend to change, there will be a lesser requirement for the numbers in these de-skilled jobs, because there will be relatively more automation.

SESSION 2: The Role of IT-based systems in Education and Training

2.1 Mr. O'Donovan (Manager, Training and Development, of the Industrial Training Authority, Eire)

Ladies and gentlemen, just to start with I want to briefly outline the organisation I am working with at the moment. ANCO The Industrial Training Authority was established in 1967, and in fact it has 2 main objectives and the objectives are to help individuals to secure jobs and to help businesses to be more successful, so therefore they define the areas of activity. The first one is we are providing training for unemployed people and the second one we are promoting the highest quality training of employed people, by means of a training advisory service. ANCO has a staff of 2,300 and it operates a network throughout the country of 18 training centres. These training centres are purely and simply for the first objective, training of the unemployed people, as well as that we have a staff of 200 training advisors who are constantly in touch with companies, assisting them in their training needs.

One must remember that Ireland has a very high percentage of small companies, in fact 96% of all our companies employ 50 people or less. It is interesting that these training advisors have identified a number of needs for the small firms and they were in the area of marketing, finance and product development. The immediate response to that was to mount 'in company' courses to assist the managers' of the company's needs. But that became very costly because as a company employed 50 or less it likely had only one or 2 people at managerial level, therefore it was almost a one-to-one training situation. Our training advisory service began to think there must be a more effective way and ost effective way to get the training across, and that is where we came into the area of computer based training.

Back in 1981/2 we took 4 people and formed them into a team. In the team were 2 training advisors, a staff development officer and a computer person; they in fact worked together with Digital Corporation. I must say also they had a lot of help from Dr. Camstra, who is here today with us. They worked together to form a course which was on finance for the non-financial managers. That course was developed on a main frame VAX machine and then it is down-loaded to a stand-alone Professional 350 Digital machine. It is certainly a hundred percent computer-based training and has approximately 8 hours training time. It is supported by a certain amount of written material, a learning guide, a reference book, a book of additional exercises and a book of model answers. It took approximately 300 to one hours to develop. We do have to remember that at that stage we were dealing wityh a very inexperienced team of developers and we were also dealing with a software system that was itself under development and therefore we were only field testing it. This has now changed and as a result or implementing this course in companies, and the way we do that is two-fold. In one case a company manager can go to any one of our training

centres, there are 18 training centres around the country, and book himself in to sometime on a the computer himself and go through the programme. The second way is that we ourselves are hiring out a number of these computers to companies for a period of time to allow the managers to work through the programme. It usually takes 2 to 3 weeks; they can do so then in their own time and their own way.

We are now determined to put more effort into the development side. We have set up 2 permanent teams. The teams are small, consisting of a project manager, 2 courseware designers, 2 courseware programmers in each team, and then backed up by a video consultant and a graphics consultant who will supply services to both of those teams. We are also still working very closely with Digital, and in fact, Digital have produced on the market in the last 6 months a machine which they call IVIS, standing for Interactive Video Information System. This is purely and simply a Professional 250 stand-alone micro computer, backed up by a video recorder which will provide on the one computer screen, and it is the same stand alone computer screen which the business man will use for his stores records, for his salary system everything else, on that particular screen it will then produce both computer text graphics and video pictures. It seems to be the ideal machine as far as we are concerned.

One of the intersting points to note is that although we have 18 training centres around the country, and the bulk of our staff are in those training centres, the initiative for this development came from a smaller group of advisors. When we look at it, it appeared that in fact our training centres were quite happy to remain down here in the lecture-lab situation, they were where we had an instructor, 14 trainees and they went through a very formal course over anything from 12 to 32 weeks. At various stages since 1973 we have tried to introduce self-paced instruction, audio-visual film strips or video tape, but it's not until now that we started to bring in the CBT. Not until this year when we started now to produce the IVIS programmes, that we are seeing the impact this can have on all of our activities in the training centres. Take for instance, one of our courses, welding, which is putting through maybe a 1,000 trainees in 1 year. This is what we call a continuous intake type of course, where trainees are at various stages and where as soon as one leaves to get a job they take in another one, so that the instructor has a difficult task in dealing with them. With our CBT type programme he can now send the new trainee to the computer to do 2 hours theory work and to develop himself and when he comes back to the instructor the instructor can deal with the physical skills. As the development goes on the student can take the various lessons on computers and develop the theory side of it.

So this is now having a big impact, also in our training centres. Courses we are presently developing we have the finals for the non-financial manager which is pure CBT and that's approximately 8 hours introduction to robotics, and there's a 5 hour one which is an IVIS type one, costing and budgeting will be purely CBT, 8 hours hydraulics

and pneumatics will be CBT, welding technology will be IVIS and the problem solving decision making, which we haven't started yet, but we do intend to make it an IVIS situation.

I must say that we have signed an agreement with Digital so that we have access to their whole library of courseware. As far as we can see there is very little available at the moment in this field, but they are developing a number of courses which will also be very interesting to us, one of which is introduction to computers, so that everybody all 40,000 of our trainees a year going through our training centres will have this course available to them. That is one of the reasons why we are not developing this ourselves. The future developments that are of interest to us, are the linking of all this computer-based training together by means of a network. These are the things we are hoping to do in the future. For instance our training adviser, it would be very nice if our training adviser could come into the office in the morning and switch on his VDU terminal at his desk, he could check that the records first to see which of the companies he is responsible for has been working on courses, if he checks his mail file then he could that there are urgent notes that he needs to pay attention to. If there is a call for help from a particular company he would switch onto his inter-terminal talk facility to solve the problem with the company over the system. He could then look at the detail records for another company and decide to send a memo to that company suggesting that a particular lesson be repeated, and so it could go on and on and on, and it could in fact revolutionise our whole approach in the training advisory service. These are the things we are working to, we certainly haven't arrived there yet, but we would hope to do so in the not to distant future.

Question

Mr O'Donovan could you tell us what is cost you to produce video disks I know that it can vary very, very much, but in general what does it cost that video disk on welding and how will that be made available to our industries, our institutions our countries?

Answer

If I could take the second part first, our agreement with Digital is a two-way agreement. Number one, anything that we produce ourselves will be available to anybody else in the world, through the Digital network, that's the first point. The second point is that, and I think one of my colleagues referred to it earlier on this morning, we are luckly in the training field in Ireland, that we do have the finance available to get into this type of development, our educational system doesn't. So we are not paying a lot of attention to the costs at this stage, we are saying let us develop them, let us see what the costs were and see then if we can bring those costs down. Video disk work that we are doing we are producing it certainly with

our video makers in Ireland, sending it to Digital in Boston to be pressed and to be produced.

Question

Before you send them the tape, that's where the costs are?

Answer

Our team would do a certain amount of development by working up the story board and script and the actual filming of it is reasonably cheap, so it is worked into the development, the total development of those teams while working on the programme and we are not isolating it out.

Question

In the region of about 10,000 something like that?

Answer

Before it is sent to be pressed that would be rough estimate, yes.

2.2 Dr. Baldassare (IFAP, Italy)

First of all, I would like to explain a little bit about my role in IFAP, where it is written here head of training, well it is not really true. IFAP is briefly a management training institute in Italy, one of the oldest and one of the biggest. It started in 1959 and now it works, and has from the beginning worked, for a very large national holding in Italy, which is a group of industries at national level which is called IRE, Institute for Industrial Reconstruction, which was started just after the Second World War. IFAP and this Institute worked therefore for the training of managers in more than 200 industries, which are grouped in this group, this holding but also worked for, lets say, the free market and not for IRE, but also other industries and companies. We are now, for instance, directing or orientating towards the public administration sector and this will imply for us particular changes in our methodology and our knowledge. So in IFAP my personal role now is that I am responsible for the training of trainers section and the training methodology section, that is I run the courses, as a trainer. I run the courses for trainers in the different industries and I also care for the initiative insider the institute for the updating of the training staff. Here I will talk mainly to the problem of eduating the educators, that for me means training trainers. I obviously will relate, shall relate to the management training point of view. I cannot speak about basic educa-

tional problems or technological ones, relating to information technology, specialised ones, I would like to ask you all for some contribution on the point of view, what are the implications for the organisation of training, the training policy for training institutions, given these changes in information technology and in training therefore.

What is our experience in IFAP is that companies which we are working for ask for more tailor made training, we work on a basis of 25% as a standard programme which we offer to the industries and we run an annual programme in this direction, and 75% of our output is tailor-made training, thta is suited to the needs, to the specific needs of our clients or users. Companies therefore ask for more and more of this training on the basis of particular problems to overcome, within their structure which are basically economical or organisatinal or very often linked to the introduction of a new technology, for instance in the production process, and therefore they have to adapt the workers and the managers to cope with this changes. Essential characters of this training demand are the need for fast action to undertake that rapidly shows its effects on a relevant number of people, in terms of skills acquired and in terms of behaviour change and another character is the limited amount of resources to spend on this line and another character is the peculiarity of the company conditions, for instance organisational conditions or economical, technological, marketing, industrial relations and so on. These characters all call for very highly tailor made training.

Other changes that affect training is a very important one, I have already spoken about the changes in the training demand, which obviously derive from another kind of change. The organisation structure and the organisation of work. The companies lead the way in our case and we have to adapt our training methodologies and policies and strategies to them. What is happening now, what also we hope to happen, and we have to cope with is this, until now the organisation structure was determined by the strategy of the top management, in industry or in a company, therefore it was put at a second level, therefore they were going to use as a tool information technology for dealing with this new structure or the different kind of strategy they were choosing. What is happening now is that there is a change in direction, in orientation, and the use therefore of management information systems, which means that from now on, what is the key factor that determines the changes also in the organisational structure is really information technology, so also even the strategy is determined by information technology and therefore the structure.

Other key factors that influence training, and therefore are important for us to consider are the impact or the push. The push from information technology itself, the impact that information technology itself can produce. As it has entered our personal lives it has obviously entered the economic cycle of the society, the production cycle, it holds the market and tehrefore training is going to be influenced, but how is it going to master this process. The key point

is therefore how we are going to master this impact or these influences. The implications for the training agencies follow in terms of its organisation and its strategy. The training intervention has to correctly answer to this urgent need, and the training agencies therefore must be able to design and realise projects that respond to the whole range of needs, taking into particular consideration the time and resource constraints.

At this point I would immediately say that IT systems play a fundamental role to solve these problems, because what we have also experienced, there is a good amount of repetitive training. The problem of the educational foundation for improving the quality of basic education is that most people need a very good platform, I don't know how better to explain this, therefore there is the need of improving the quality of standard training, not to leave it to the, just the routine dimensions and at this point the information technology systems introduced to training can really play a fundamental role, but this is the crucial issue, I would like to draw your attention to, provided there is a good cultural and profesional preparation of the trainers who manager the whole process. These negations that derive to the training agency in the field of training trainers, which is obviously of particular interest to IFAP, at this moment when changes in the training, are such of those I just mentioned, and the impact of information technologies so strong in all job areas and in training to. Training activities can be helpfully assisted by computers. The base systems we have to envisage are those in the area of CMI, computer-managed instruction, which would be a natural support to the training projects. In the managerial and validation stages that give reinforcement to the whole project, geared to the individual learning needs.

Today our institute experiences that we have standard training and organised in a traditional way we have mostly face to face methodology, even for the tailor made training. Nowadays our information technology is entering the training in the form mainly of drill and practice strategy. What we are looking to is really this computer management instruction, which can jsut reinforce the project and give it a sound direction, a sound orientation. It can give also a sort of change in the role of trainers, they have to change from beng the people hwo know, who have the knowledge of things, they have to change to people who have to orient and control the whole of the training process from the project until the validation and exposed evaluation, if you want. Within this crucial issue of the preparation of trainers with these new objectives and tasks I invisage a need taking action along 3 different main lines. These are cultural preparation, technical preparation and methodlogical preparation. Briefly the cultural one, more knowledge about IT, especailly no myth about it, having the possibility to experience what really CBT can give to the effectiveness of training and learning especially, so having the possibilities of getting the results of studies, and this is also a recommendation for EEC activities, having the possibilities of knowing what rate the results of experiments or researchers or pilot projects

conducted to see what are the effects and what are the impact of CBT in different levels and categories of training. From a technical point of view, practical knowledge about the technological variables that affect the use of CBT. So especially there is a need for trainers to know about the production or market buyers that really can buy us the use of CBT into training. What are the influences of hardware production and software production, what is the correct use of how to master the process again. Then the quality of the courseware, more flexibility between hardware and software, also in systems these are all areas of activities in which the role of the EEC could play an important role. Artificial intelligence and all the latest devices or systems that culd be developed. Last point, methodological preparations, using CBT means they're really another method of work and it keeps one a teamwork, very interdisciplinary and to which our trainers I am mentioning the Italian experience but I think it could be a little bit compared with others, are not really very well prepared until now. What are the implications that last for training agencies again, from the inside they should become, or they will become, I do not know how to put it now I would like also to have some suggestions, as courseware productions centre through offering systems, the development and the implementation of offering systems and then to implement also collaboration with software houses. From the outside point of view so training agencies looking at outside, they will have to assume or to play a role of technical assistance in order to administrate and monitor the training process and to validate it.

2.3 Dr. Breukker (University of Amsterdam, Netherlands)

As a kind of a preliminary, I shall talk first about history. In the 70's there was a recognition that the new time-sharing main frames were inadequate vehicles for the development and delivery of courseware. Apart from a number of obstacles they also had to compete with other users etc. From there it followed that dedicated systems would do a good job and PLATO was therefore a logical consequence of these kind of developments. I assume that most of you know what PLATO is, and if not I will give a short introduction. What I want to emphasise here is the fact that input, output facilities of PLATO are extremely good and they surpass the quality we find nowadays in most of the computer systems we buy. More importantly the PLATO system was designed by a multi-disciplinary group of the University of Illinois, consisting of computer scientists, psychologists' educationalists and particularly potential users, and I mean by potential users not particularly the student but the teachers, the authors of future computer and instructional courseware.

Now we see independent development in the 80's, arrival of cheap micros in schools. This is the first real generation for, lets say widespread computer-aided instruction. From what we see there are crude I/O facilities, there is no user-friendly environment and most of the courseware is do-it-yourself courseware. The latter aspect enforces that nowadays some centralisation programmes are going on in

several countries in Europe, trying to the best out of all the constraints imposed by these micros, and so we can ask ourselves is this a lost generation? I mean lost for computer-aided instruction, particularly if you compare it with what we had before the PLATO system. Well, when the PLATO system was introduced, for instance at our University (we were the first in Europe to have PLATO in 1977), in those days when I worked with it I was a little bit disappointed, and I will come back to the disappointment. At first PLATO was very, very good in the input, output facilities, they were very well designed and particularly for the communications facilities. Can we make the same kind of facilities? Yes, there are networks going to develop so communication facilities are on the market nowadays, even on a better scale than PLATO, and I can show you one example of something we are actually working on. This is a picture taken from a screen, this is a task solving thermo-dynamic problems in an interactive way, and here the student can make all his drawings and pictures of the situation and interpreted by the system, etc. These kind of interfaces will become available in a short while on a large scale, so I think we should not worry too much about the hardware aspects, they will be there. But I was very disappointed about the kind of language teachers had to use, the kind of language that is used is in fact a kind of adaptation of existing conventional progrmming languages. Another disappointment was, and those 2 aspects are related, the bad quality of courseware. I mean by that quality about 90% of the courseware has a major kind, of let's say educational works, they are not from the computer point of view, they were not works in the learning process there were bad things going on then. And both the language and both the courseware reflect the fact that there was no insight in the kind of grammar of automated directive teaching. Well we should do something about it now, in the near future, so for the next generation we hould do better than PLATO. One reason, a very important reason, is tha the cost of development of good quality computer-aided courseware are very high. Its one man-year for 4 to 8 hours, even at conservative estimate I think, and then the quality.

At the moment well there are a number of design issues, the first thing is the system should be foolproof to hitting the wrong button and things like that, secondly it should be flexible and transparent, with respect to the researcher of course materials so that the student knows where he is, etc. The system should contain diagnostics, remedial explanations, there should be as little as possible restraint on the amount of initiative the student can take and the variation in responses that are allowed and then there should also be a support for authors who come from very heterogenous backgrounds. This means that both computer scientist may want to use it as teachers in any subfields, so what we need is several kinds of levels and also the kind of integration of all those kinds of both computer science and lets say subject method specialist, within that framework. Well what we see nowadays is the lack of development tools, lack of knowledge about in the direction for learning. What are we going to do?

Well I propose to design an authoring environment consisting of the following kind of things. The input, output facilities should be dri-

ven by high-level language. The software development environment itself should at least match what is nowadays available for other languages, like for instance Interlisp, which means editors, all kinds of editors particularly for I/O facilities but also for the programming and the databases. Traces, de-buggers, etc., this is going to become conventional stuff within the near future for any kind of software development environment and so it should be for computer-aided learning as well. But those specific for computer aided learning is the authoring language. The authoring language should be based upon the 'virtual machine' that takes the teaching system, and I emphasise teaching system, not teacher-student interaction, as a basic conceptual unit for all kinds of actions. One example, I have been working on an example of such a language and ... with whom I have been working, ... that was a rudimentary kind of authoring language based upon artificial intelligence now it seems, ... we couldn't sell it to the industries, until now. We have contacted several industries they are not intersted because they thought demand was not sufficient. What we need as well are levels of authoring. What we think is that there should be shelves within that system, with some documentation about it, where lets say computer teachers can easily put in their courseware, and there should be a very low level as well what I call the C level, which is similar to the C language in the UNIX system, where computer scientists can do the organisation, flexibility and maintenance. This is as far as the authoring environment is concerned.

What we need is now to making the shelves a kind of library of teaching strategies and in order to build such a library of piecing strategies we need a lot of experience with experimental authors, so there should be development time for the system for a few years. The second thing is the way to achieve that is empirical research that can be started even now and we are doing that kind of research now, on simulated man machine interaction, which means actually 2 terminals that are connected and in front of one of the terminals is seated a teacher and at the other terminal is a student, and they interact with one another. You can easily see that, that kind of interaction is different from face to face and simulates in a certain way the future system. Moreoever we should have taxonomies of learning tasks related to teaching strategies. And the second thing is that there should be levels of intelligence in the courseware, the system should be able both to make conventional computer-aided instruction which should have a smooth transition, to go to whats nowadays called intelligent computer-aidded instruction. You can see the scale, for instance, you can have pointers in the system that point to certain input, output frames, and on the other exchange you can have a deep knowledge of subject matter in the system, and the system should allow for both these options and all the options in between. Moreoever it should have also kinds of strategies built-in, like pre-specified diagnostics, which means that from certain reference patterns from the student you make an inference, of misconceptions of students, the system should allow for those kind of choices as well.

OK, what will is cost? What I think the course system will cost is about 40 man years in 4 years time, inclusive of a lot of testing. Building up the libraries is an additional phase that will cost another 40 man-years in my opinion, and so such a whole project can be done in 6 years because the library development can start after 2 years. What kind of people do we need? Well, keep in mind the development of the PLATO system; it is a kind of similar enterprise, only in this case I should think the system shouldn't be to dedicated to one particular piece of hardware. What we need is at least also some hardware designers, computer scientists, software psychologists, as they are called nowadays, those are the people we need during the machine phases. Artificial intelligence, educational and co-operative scientists and last but not least the marketing people.

Question

You have mentioned the development of a library. What kind of use of this library did you think of in regard to training and education? What age of pupils or students or vocational training, general education or things like that?

Dr. Breukker

We specify educational strategies so for instance if you want to have a kind of drill and practice task there are a number of issues on feedback, that can make for instance various sources on what kinds of feedback you want to have, so by knowing there are those types of feedbacks you can choose, I want to have this and this, and the library containing a number of shelves, you can fill in the subject matter then, and all those kinds of slots, that's what I meant by a library.

Question

We would like to know from you how you see the transferability of the materials that are created on this sytem, because surely if one puts that sort of investment into development you would want that recovered over a large population of users. Now that assumes that either your proposal existed to some sort of definitive standard or it would have to be restricted to the sort of populations which accept your approach there.

Dr. Breukker

One of the major design issues, how far transportability can go, because of course you want to have the maximum of transportability, but then we have to sacrifice all kinds of incomprabilities and make all kinds of transducers in a certain way, particularly for the input,

output kind of facilities. So what I think is, it is part of the design process, how deep one can go, but well there are all kinds of things decode and all those kinds of transformations I am thinking about and compliations.

Question

What worries me in your talk is you say that industry is not interested in your programmes, do you really think you should develop this kind of programme without collaboration of publishers, hardware people and not only doing the work but financially? You have also said give me 6 years to finish such a programme, well I think this is 4 years too much. If you want to develop such aprogramme you should have a strategy that should be a kind of adoptive standard. Two it should be ready in 2 years and not in 6.

Dr. Breukker

I want to be realistic, I mean the system will be ready then in 4 years and it will be realistic in the sense that it is tested and marketable, because you need for designing the system I can be sure it can be finished in 2 years, but don't be fooled complete with bugs, documentation will be bad etc. and everybody who has experienced major kind of software systems, they take 4 or 5 years UNIX system did develop also after 4 or 5 years and it is something of a complexity that is comparable. So I would not under-estimate. The reason industry was not interested, it was not the time-scale, they were not intersted anyhow, even Control Data, although they had already on the PLATO system our DART system. We had developed it already and so we could say we can go on from there and develop further, and they were not interested at all.

2.4 Dr. Gastkemper (Head of Media Technology in the Dutch Open University)

In a way its always a problem to follow on so many speakers because much of what has been said could be said by yourself. But I would like to follow up a little bit on Dr. Breukker's words and I will try to be as down to earth as possible. In a way, I agree with his main concern with the quality of courseware for education and training. I think that has been neglected for many, many years by delighting in tools and machines and other things like that. I think the concern for quality of courseware is a main thing which we should centralise upon, even by the policy making people. Dr. Breukker suggested we could make an effort to arrive at that point, by developing a system, now that is a little bit misleading in that sense that his system is not only a system in a technical learning process. I think in effect that will be the most important and difficult part of his work, but so far for Dr. Breukker's words.

Until we reach the stage of such systems, quality can be guarded through rational anaylsis of the function of computer-based instruction and perhaps that must be annotated a little bit upon. I think that functin-specificity is a very important thing in computer-based training. In the first pace, its not the same to use computers in training as in education in general. There is a interaction between levels of education and functions you can allow computers to fulfill. There is an interaction with objectives, learning objectives with the content of the materials, with the level of education in general. Apart from that information technology is best used is to raise the level of skills, from problem solving skills, in education in general and perhaps even otherwise concept learning and content learning in industrial training. That has to do with scale, that has to do with all the other factors I have already mentioned, but to take a more concrete example lets start with my own Open University.

I am working in the Dutch Open University. It is not ready to start up, but it will happen in this Autumn, September - October, but so far we have already decided on some policies for using computer-based training, and that is very easy to explain, taking into account on what level we are going to produce education. Taking into account what contents and skills and objectives we try to reach with these methods of training and education. We concentrate upon 3 functions of computer based education. First, as a machine, as a computer of course, second as a simulation tool and third as an instructional tool and a testing device. The first thing, using it as a computer is, well it speaks for itself but it is difficult enough for allocating a real good function for these machines. In our environment you not only have to analyse its function but to integrate it as well, and that means that in distance education, which the Dutch Open University is going to offer, the integration of the machine like use of computers by students is not an easy thing. You should either surround them by people systems, or surround as man-machine systems like help functions, like error messages and then build upon in a pretty complex and comprehensive way. That reminds me again of Dr. Breukker's suggestions about the far more intelligent CAI system to use for such situations. You know things like multiple taskings, switching from level language to the other and so on, are actually needed in that situation. Then to keep the quality of the application that is a big task. As a simulation tool for education the situation even grows worse beause many, many educational situations make use of simulations. But in general people tend to neglect that simulation in itself is not identical with education. Its just one kernel for an educational system and is a very important one and can do a lot of specific things for education, which was not possible before the coming of computers. Nowadays it is really needed to realise that the simulation as itself has to be built into a man-machine system, or face-to-face environment where people can explain what is happening and help you if you are going wrong, if you are interpreting or overlaying things wrong and so on. So, the third level of usage of the computer in education is that level of more traditionally indicated as an instructinal tool or a testing device, as for a testing device that

was already mentioned by one of the earlier speakers, in the teacher-training area. I agree with her completely that it is a very important area, but as an instructional tool, as I already mentioned before, we try to concentrate upon the cognitive skill and perhaps problem solving area. That is again a difficult task but there is large promises, I think once you realise that it has its restrictions, limitations, then there is a lot to be done and gained with the use of computers in this area. It should be donw-to-earth, it should not reach for the stars or something like that but even then a very, very down-to-earth analysis of what should be done, you can arrive at some big goals. In this context the usage of video and the integrated uses of video is growing more and more important. Some speakers before have mentioned them already, and some after me will do that doubtlessly, but I think the coming of this new technology does have its promises but asks for some extra, lets say, procedures and obstacles to overcome. Everybody is talking about obstacles and solutions and in general I think professionalism and quality of the material we are offering and the cost levels are dominant. Now I am not speaking from the point of view of policy makers, not the EEC people, just one of the makers of CBT. I think the professionalism and the quality of the materials can be dealt with through R D, like Mr. Breukker offered, through teacher training, through procedures, through teamwork, through analysis and integration of the materials themselves. The cost factor can be dealt with by information systems, well designed information systems like Mr. Rasmussen talked about this morning, like distribution, like hardware solutions, like cross-compilers and conversion methods and perhaps like through a change in strategy. I must insert one remark, again here is an interaction between, on the one side education, and the other side training systems, depending largely upon scale. In training systems which will be developed for large institutions on numerous users, there isn't so much need for lowering the cost, they pay for themselves, they can be short living but they will be effective and efficient themselves and have more often than not a restricted area of cognitive skills and content learning as a body. In the more general educational area there is a large requirement for lowering costs. Not only through the social-economical status at the moment, but also through the sometimes far lesser numbers, doubtlessly more stubborn views teachers generally have on their own education which they teach to students. So one of my suggestions to overcome this obstacle in the more formal education would be try to deviate from the distribution of end-products like a completed educational programme in CBT format, but try to concentrate instead on, lets say, half products. The integrated technology we endeavour now, like video disk, could offer a nice opportunity to do so. If you are able to co-operate with many institutions, even across countries, to develop a set of very, very nicely developed video disks on some topic or area of topics or subject then you'll be able to produce them at relatively low costs iwth the additional benefit of having the opportunity to develop the programme, the computer control and learning programme you are going to use with the disk more or less independently. Of course not completely independently that would be impossible, but it gives you soem flexibility as an end user to adpat

the ting to your own needs and that could be a very, very important gain; lowering the cost on the one side and offering your specific needs to solve on the other side. I would like perhaps, to suggest a few things more, but completely in line with this approach is to have the possibility for using standard hardware, relatively simple interconnections standardised alos, and as many hardware tools and software tools as possible for making up the distrubtion as broad as possible.

Question

I find the concept of producing half products rather than the end products very interesting but it requires of course that the user is capable of taking the half product and turning it into an end product for himself on his own, so do you think that the typical end user is capable of doing that or are you proposing that there should be ways of training users and traininig, etc.?

Dr. Gastkemper

Well, I am not sure what a typical end user is. We for instance would be able to do so in our situation, but I agree with your idea that not every end user will do so, or be able to do so. On the other hand there is an interaction again with the systems like proposed and all kinds of help through national bodies, through all kinds of endeavours which are going on right at this very moment even in Holland, to arrive at regional centres for development of instructional materials and things like that. I don't think there is a general answer to encompass every possibility and every problem in your question but this is only the start of an approach. For instance a counterpart could be, not in the area of computer based programmes themselves, not to divulge the programmes as such, but the intermediary level where the concept has been formulated. There have been approaches in the past, doing so, for instance on an intermediate abstract written language, using that language to define what programme you are going to offer to the student before actually programming it. I like such approaches but they don't work so fine. Now it looks more like the cost factor of setting up integrated systems will depend for a large part on manpower of course, but there the flexibility should go in, and on the other part software things like video, and I think thats onepart you could lower the cost on through this co-operation, but it doesn't make disappear the other problems of course.

Question

Another intersting thing publishers and people who develop courseware generally have commercial interst in putting out their products onto the market. They go to great lengths in what they call protecting their project, which means that you very seldom have access to source code which is something that would be absolutely necessary in your

proposal, namely take half product and modify it. How will you go about convincing producers of courseware that they should provide access to source.

Dr. Gastkemper

Its not really indeed, I think you should have access to the design of the course or an application, but not to the source code themselves, actually I'm proposing not to finish up with the source code, and then distribute things, no, before, and publishers they can take part in this whole scheme as such they can take for their responsibility to produce the disk for instance and have a large audience to sell it to and leave the programming of the materials which we are using to control the disk and to manager/student interaction to the end users.

2.5 Mr. P. Hansen (Denmark)

I want to start by pointing out that the most important task of the EEC is to create new industrial activities and new occupations. We have seen the so-called third industrial revolution, micro electronic industry develop into now, but we have not seen it create a remarkable number of work places. On the other hand, information technology continues to influence the existing labour market. It has been estimated that 30 to 60 millions of jobs in the EEC in some way or other will be affected duirng the 80's as a consequence of the development of micro electornics and information technology as a whole. This industrial revolution is characterised the exhilarating speed of technological change. The necessary aujustment of the labour market will have to be carried out within the next say 10 or 15 years at the latest. During this peiod, at the same time, we will experience that the lifetime of many industrial products will be shortening. New products and new production methods will have to be continuously developed. That means, in summary, that there will be a still growing need of mobility in the labour force as a whole and at the same time a considerable and fast proceeding change and content of the single jobs. This certainly means that the communities, and the enterprises will have to ease the necessary mobility and the flexibility of the labour market, by considerable efforts in the field of education and training. Information technology is, of course, not the only technology that infringed the employment situation in our countries. But information technology is of special interest because of the size of the world market for information technology and because of the heavy competition in this field from the United States and Japan. During these years the EEC is losing markets in the world market and this process risks to grow. The strategy of EEC must be to stimulate industrial innovation, and for this purpose EEC conducts a number of programmes and projects. Among these projects we find the project, which we discuss today, and which I consider a very important one.

And now I return to Danish scene. For the time being the Danish politicians and the governmental authorities consider possible procurement of a hybrid network. They have a long term goal which they call a nationwide integrated network for all types of communication, that means point to point communications, allocated communications, railway station communication, consultantion communications, covering the whole spectrum of audio, video, voice, text and data communications. The hybrid network mentioned is to be seen as the first step ont he pathway to the final goal. This hybrid network is conceptually speaking, a full integrated network of broad band capacity for the main sections of the network, but only for the main sections. I the subscriber networks there will be separated local telephone networks, respectively TV distribution and loop cable systems in the single communities. Today a little more than 50% of the Danish households are connected to the community antenna TV system. The idea behind the hybrid network is to inter-connect probably most of these systems. Furthermore, it is expected that there are aobut 5 to 600,000 new households will establish new community antenna systems. Altogether it means that up to 75% of the Danish population will be interconnected via CATV systems in the next 5 to 10 years.

This means, as I see it, that new possibilities for establishing interactive services on cable TV networks will arise in our country. It should be

emphasised that things are not being done very easily in Denmark, the politicians are not fully in accordance with each other on this item. But I say if it is possible to have a final political decision on the hybrid network in Denmark then we will have a new tool for inter-connecting the homes and it will be possible to create and manage interactive services on the CATV systems and the trunk ways of the old system.

That perhaps is not that important to you but when talking about Denmark I use it as an example because as I see it the issue of cabling or recabling of the countries within the EEC are under consideration in several of the countries. If we forsee an expanded use of cables for the whole of TV distribution and for interactive services, then we will have at our disposal a network suitable for remote education and training service.. We will be able to create remote multi-media assisted learning and training systems. We will have to develop education uisng all the media, audio, video, text, data, etc. in integrated systems. You have to create new hardware, new software, new courseware and parallel to this you will have the development of the necessary communication facilities to look after. Looking upon it in this broad way I think this will involve a lot of partners, hardware manufacturers, software houses, publishers, educators, telecommunication enterprises, PTT's and so on. In my opinion the necessary development will have to be supported and co-ordinated by someone why not the EEC? If you make a strong move in the EEC then the results will certainly be a valuable contribution to the necessary adaption to the labour force to the changing environment in our countries, and at the same time the initial development of our hardware, software, courseware needed might lead to new production, new projects and growing export and a better position of the European industry in the World market.

Question

This hybrid network, what exactly is its function? For example can you see it for distribution of software, can you make terminal access network, can you supply software for producing courseware? You can define many functions which you can put in a network and you talk about a very general network but what exactly is the function of the first steeps of the network you propose?

Answer

In Denmark, as in most of the countries where community antenna systems are developed, we have two different distribution systems,we have one real communciations system in the telephone network and we have another distribution system for radio and TV programming by transitters and antennas and cables and so on. The idea is to integrate these 2 different systems in one. The hybrid network concept will be done in the higher part of the hierarchy, the network hierarchy. In all the trunk ways it is the meaning that TV distribution and radio programme distribution should be conducted in the trunk cables and radio links used for telecommunications as well.

2.6 Mme Radisse, Ministry of Education, France (Translated from the French)

On new technologies, well of course this gives us new instruments, creates information and of course, new conditions in terms of communication, so that this is a real auxillary really, support. In France, we have tried to catch up on the delays with respect to our own possibilities in this field. We have taken certain measures, in three different directions. First of all introduce the instruments we have into profesional training in the industrial sector and the tertiary sector, which implies changes of course, in terms of actual training in concept and content of the teaching. It all has to be completely recorganised, taking accont of the impact of the technologies, and the whole question of apprenticing as well. Then we have to use the resources of information technology and communication in order to improve the effectivenss and efficiency of teaching, as a whole. This means a sort of renovation of teaching, using information technology and communication technology, new teaching and learning methods and new ways of having access to knowledge and known-how.

In France we have made a choice here: we want to put these possibilities, as a priority, in the service of pupils who have difficulties. And thirdly, we want to train specialists for our own input, but also bring in the whole integration of technology and communication as part of the basic teaching and education. That is to say, to make sure that all teachers and students who are currently learning can have some knowledge of these new technologies, at first hand or perhaps a little more distant.

Now of course, this is really in line with social justice but also social efficiency, economic efficiency as well whereby all the adults of tomorrow will be able to adapt to a society which is changing at the moment and which will be of course their society tomorrow. Now, this is an ambitious step, it involves the following: that informatics should not be considred as an autonomous discipline now, but as a dimension of education and also a way of learning. We want to try and bring it into all levels of teaching and training, from primary schoool up to the end of the secondary training and teaching period. Not, of course, university because that's part of the professional training that I'm going to go on to in a moment. Now you can look at my paper to get all the details which I will spare you at the moment. National education is trying to participate actively in other forms of action, action carried out together with world centres for informatics also to try and help young unemployed people and of course the large

numbers of people coming form the Hautes Ecoles. We have informatics groups - and summer schools and universities as well - on specific subjects, workshops really, where teaching is given there as well. We also have developed another thing, going to be operatonal in September, it is a series of transmissions on television by the Ministry of National Education. This is aimed at a broader public and then leads to correspondence courses, training courses as well. This implies the following: we can then place ourselves on a system, an overall system, training system which is at two levels. First of all, to train the people who are going to be teachers. This is done for a year in centres, or its going to be, probably will have 25 at the end of the course. The overall figure that we're aiming at will be 500. The people trained at the centres then will be put into teams, 27 teams at the moment in France. They will then be teaching their colleagues as well in schools, properly equpped schools. 20,000 a year is our overall figure that is our long-term goal.

We are going to have three support centres, this will be set up at the end of the summer of '84 so that there is proper impact on the public as well, for this purpose we will have cassettes, documentation, and any matter people will be able to comment and so forth assist in that way as well for the courses. We will also need of course material, software support as well. Our main concern has been coherence in pedagogical terms.

First of all, the software has to be portable, and we have to make sure that material's compatible as well. We have taken a certain number of measures to make sure that these two things will be possible and that the system overall is properly coherent. I think, as I said, the best thing would be for you to look at the details and the figures form the paper. The only way to get this coherence would be to allow one single body to produce and disseminate the courseware, which is now possible. We have about 700 hours of activity, that's to say that what is actually ready and 100 models are being prepared for the summer of '84. One final point, this courseware is all put together in a library, a teaching library, that's linked to data-bank, data-base. Experiments are going on at the moment in a number of areas in France, 5 towns in fact, to implement in teaching these real resources and also work out means of access, networks in other words. We also want to have some way of using all the reosurces of communication, telecommunication. Thank you.

Question

Is there any connection between your general project and the thing which is going on under the heading of two-way cable television in Lyons?

Answer

SESSION 3 : Existing IT-based systems and setting requirements for future ones.

3.1 Dr. B. Camstra (Netherlands)

What I'm going to do is to give you a ground view of authoring software. Authoring software is something which is really relevant only within a sub-field of IT. IT as we all know is a much broader field than the sub-field that I want to cover, which is computer-based training, or computer-based learning or computer-assisted instruction or whatever you want to call it. My interst is in how do programmes, with which people learn come about, how are they made, how can be assist the development of these programmes.

As you are probably aware, there are three major components in CBT: authoring, delivery and management. Authoring the programmes must be made, someplace by someone, delivery they must be delivered to the user who is a student and the learning process which takes place must be managed, monitored and controlled. There are a number of information flows between those three major components. What I want to concentrate on is the authoring component. I've listed for your convenience, a small number of key terms that I view relevant for these three components. For authoring, what we want for an authoring system or an authoring environment is power, flexibility and efficiency. What we want in a delivery situation is at least quality, the fact that the programmes that are taken by students do have an educational quality that we think is necessary. Availability means that the machines that are available. There's the aspect of economy, in various meanings, one of which being economy of scale. For management the relevant keyword is that you need control, software and many cases it also entails some form of networking.

Now, this is a very short introduction into the general concept of the courseware authoring, what I would like to do now is present to you a grand view, a grand tour of authoring tools. The tour that will start in 1960 and that will end provisionally in the year 2,000, so its clear that it is part- past it is part-present and it is part-future. The course of development started in the beginning of the sixties by using general programming languages. There was a very simple reason for that - those were the only ones available. Some of these are still being used to develop education programmes. Roughly ten years later, the dates are not that relevant, there was a second generation of authoring software in the form of specialised CAI or CBT authoring languages such as Coursewriter, Pilot, Tutor etc. These are still quite a bit in use. Again roughly ten years later, in '80, we saw the development of a third generation of authoring tools which can be designated as the courseware drivers, programmes developed in such a way that the user need not necessarily do real programming but can develop lessons in a more friendly interactive manner. PCD I the Plator driver system is one of the examples here. They are currently used quite a bit.

We are at the brink of a fourth generation of authoring tools and I call them integrated authoring systems. They are integrated becuase they have in them a combination of all the capabilities that have so far been developed in the earlier generations: the power of authoring languages, the ease and relative efficiency of courseware drivers etc. I'll show you one example of such an integrated authoring system that is currently being developed in my firm, it is called UAS. The Regency Course Generator of Regency Systems is another example. It is probably going to take another 5 years before we can see that those are going to be used. Finally, there is a fifth generation under development and preparation. The fact that this is the fifth generation is of course, apt; the likeness to what is going on somewhere else in the world isn't really just coincidence. And those fifth generation authoring tools, authoring systems should be intelligent authoring systems. I need not tell you too much about that becuase J. Breukker has already told you most of the things that I might be willing to tell you about. The interesting thing is that there are currently as far as I know, no intelligent authoring systems available there has been one pre-cursor which is called the DARI system which was deisgned by Dr. S. Cerri and implemented by J. Breukker and us in Amsterdam in '78 - '79. My position is that we have seen or are seeing a gradual change through these five generations of software.

First I will now present to you an example of the fourth category, the fourth generation, that's the UAS system. It is called UAS becuase we think it is a Universal Authoring System. It is universal in the sense that it tries to integrate all the components in all the functionality that were only partly available in the earlier generations of authoring systems. This is a very rough sketch of how the components of such a system might fit together. In the middle of it, there is a powerful authoring language on the lines of the second generation autoring languages, but there is also a complete courseware driver-builder which means that the user can use a graphical episode editor to interactively build a series of learning episodes without having to do programming. The interesting thing is that these components are as the term says completely integrated, which means that from such a courseware driver you can jump out to source code which you have written yourself etc.

Another apsect would be that the system will be completely tunable which means that the user can define and re-define all the relevant aspects of the authoring system. It will also provide the user with a library of existing courseware drivers in such a form that he can make copies of those drivers and completely adapt them and change them according to his own needs. The authoring component of this which is the upper sort of more than half, produces the lessons in the form of an intermediate code that is ultimately interpreted in the target machine and for that we are currently taking the IBM PC. We have plans to have a range of microcomputers that are capable of functioning as a delivery machine. Now this is an example of fourth generation authoring system that will be produced more and more in our field becuase of the need, great need for integrated and powerful authoring environments.

Now the relative contribution, the extent to which all the systems have been used or are used, I've tried to put in a complex picture, hopefully not too complex picture. There is a time line form 1960 to the year 2000, there is 100% here and there is 100% over here, which means that vertically it is always 100%. The lines that I have drawn designate the relative proportion of let's say, lessons or applications that are made or have been made with the particular generation of authoring systems. I must say that these lines that I will show you are my own private opinion, there is no research, I have not counted lessons to see whether they are, what percentages has been built using several different authoring systems. This first picture, is the easiest of course, it shows the relative contribution of general programming languages in courseware. Initially of course, 100% of all courseware was developed using these general languages. Currently I would say that, maybe I was too optimistic even here, that a certain percentage of the courseware is being developed using general programming languages. In the year 2000 I expect quite little of the courseware to be produced with these first generation tools.

The specialised authoring languages might fit in like this: again they started up in the '70s, currently they take quite a bit of the percentage of the courseware that's being developed. I expect that to decrease when more and more powerful authoring systems will become available. The courseware drivers are currently being used and produced I expect will not have a very important life-time, I expect that their contribution will go down quite drastically and finally be relatively minimal and then the rest of course is left ot the fourth and the fifth generation tools, the integrated authoring systems and the intelligent autoring systems. Currently, its all more or less zero but in about 15 years we might epext quite considerable relative contribution form these more powerful and currently being developed authoring systems. OK, that more or less finishes my presentation, still I have tried to put my feelings on the subject into a couple of theses that we might have a quick look at.

I think that EEC should be very active in promoting development of fourth and fifth generation authoring systems. I think those are the tools that we need to expand the use of information technology, at least computer-based training in the EEC and there should be a programme promoting the development of the authoring tools. As a kind of an afterthought, I decided to say that authoring systems, of course, should also always include also delivery software and management software that is sufficiently integrated to be functioning as a whole. A general recommendation is that authoring systems should be implemented at as high a level as is possible, I mean in terms of an implementation language in order to be as much possible machine independent for improving transportability of machines and also to counteract obsolescence when new generations of computer are put on the market. As a very short term suggestion to EEC I would say it might be a very good idea if EEC made a programme, I'd call it 'Hands on Introduction to Information Technology in Education and Training' which might give the general public at least an idea of what infor-

mation technology is all about. So, not a booklet but interactive course running on all machines that we have available in Europe. Maybe some of these theses could come up again in the discussion of short-term and medium-term plans. Thank you for your attention.

Question
(Tim O'Shea, Open University, UK)

What benefit, assuming your predictions are correct, what sort of benefit can we expect, is it in the area of costs of instruction or what?

Dr. Camstra

Well, the benefits of intelligence, I don't know whether I have to go into that subject, for you specifically, but intelligence is one of the things that I think to be promoted brings about at least ultimately, an increase in efficiency of the developing of interactive programme. But more importantly it is about a much better understanding of the nature of the learning and of being implemented as well as subject that's being dealt with. The integrated authoring systems, there's another one I think should be promoted, brings much wider variety of tools into the hands of the people who can do useful things with it, they provide the user with tools to relatively efficiently and quickly implement the course according to predefined instructional formats. It also gives the professional user the tools to develop the specific things that he needs to develop, which have difficult simulations in them etc. I hope that's somewhat on the lines that you think.

3.2 Professor P. Gorny (FRG)

Ladies and Gentlemen, I try not to stick to my transparencies which I prepared because many of the things that I wanted to say, have been said and I don't need to repeat it. I think I can continue from the things that were said by preceeding speakers. When you see information technology and education and trianing then we have the training of professionals in informatin technology as one part, we have literacy and information technology just mentioned as an EEC programme. This contains something like competence in handling information technique but machines, but handling information in a responsible manner. The third way you could see information technology as an aid, as a medium in all subject matters and in school and in service training. I want to distinguish these two areas since the motivation of industry or in-service training and the general school system is very very different. The school system has, for example, the task to educate in a compensatory and emancipated way. Industry wants to train people and they are not so much interested as to what happens to the 'drop-outs'. The general school system has to care

about them, so when we use information technology as an aid and as a medium we can have these applications. I've mentioned them before, I don't want to go into these details any more. The present state is not very optimistic: there is poor hardware, the economic or human requirements are not fulfilled, worst, with the home computers and small personal computers. If you have a lot of money, some of us perhaps have, money to spend let's say, 30 - 40 thousand ECU for one work station, then you can get a machine which fulfils all the requirements you may have but that's not the normal training situation. We have poor teachware or poor courseware, the requirements of the cognitive ergonomics, educational requirements are not fulfilled. That's where my research experience comes in because I'm doing research in man-machine interaction and cognitive ergonomics so that's why I suppose I've been invited to be here. Then there's one thing which happens, the courseware produced, and this is worrying me very much. The courseware produced leads to very conservative attitudes in teaching since you cannot change these expensive products so soon as perhaps you would like to. If you have some new ideas you have to stick to the old courseware; this is a very difficult thing in regard to educational systems. Well, I hurry to keep within my time limits.

The requirements for future, we've heard some of the requirements already, the requirements should include multi-general system, not only a screen and a key-board, but at least some graphic input and output, some audio and vocal input and output. We have to think about those people who do not learn so easily by looking at things but who want to hear it, this is not yet supported by our teachware and by our systems. You can buy the machines, I know that, but they haven't been implemented in educational systems yet, except some experimental things. So the machines should not distract from the educational because of some bugs or bad key-boards, or bad screens, crude colours and so on. They shoud combine the possibility of tutorial simulation and problem-solving n one programme in an integrated way. We have heard from Dr. Camstra, and Mr. Breukker has also mentioned the same goals, so the computing power should be combined with cheap production. Not so expensive as in the moment with the kind of producing the disc since I want to throw them away after one or two years because they are not up to date any more.

Very large data-bases should be accessible from the micros, from the work-stations and there should be inference systems behind them, expert systems, including all that what we call 'artificial intelligence' in the moment. So software should not be fixed to one pedagogical, one didactical approach, or to say with the Anglo-Saxon term pedagogy instead of didactics. The programming languages have been mentioned too, they should be those for problem solving up here should be smalltalk-like or prolog-like or something like that, I don't say it should be smalltalk, I don't say it should be prolog, but it should be the class of languages of that kind. I think we could manage to have these things integrated in one system, we would come up with teaching with teach-ware and teach-ware systems which could help us quite a lot. I think that should be enough. Thank you.

Question
(Tim O'Shea, Open University, UK)

As your talk went on I got more and more alarmed, it seemed to me you want to throw everything that is currently around and put it into a big pot. You didn't seem to be appreciating that some of the things you were talking are quite incompatible. For example, samlltalk and prolog represent totally different philosophies of programming. What possible sense could it make to try to combine the pair of them in a single environment?

Professor Gorny

I didn't suggest to combine them I said there should be languages, classes of languages in plural, like these two. I don't think we should have one language but we should have, for example, for the access of data-base and to construct old data-bases, related languages like prolog and we should have operational, but orientated programming languages like smalltalk for the other purpose, I think we need both, I don't think we can make up with one only.

Question

Could you estimate the cost of a work station running all these languages?

Answer

Well, at the moment if I would have to construct one I guess it would be about one hundred thousand ECU, at today's prices, and I think this is too much, too expensive. It has to go down to 1/20 to 1/50 of this price, to be realistic for educational assistance.

3.3 Mr. O. Holst (Denmark)

I've had to cut down my presentation to approximately one-third so I'll show one third of each transparency, and you can guess what's in the rest of it. Educational technology, what is can do, what it can't. I think its important to look a little bit backwards to look at some of the reports and books which were published in the beginning of the seventies. I've only put down one reference of James Martin 1970, where he described the scenario for the information society 15 years later, which is in fact next year. You can find a lot of repetition between what he wrote then and what you find in many of the reports being published nowadays on banking at home, shopping at home, working at home and other things. He also came up with the universal response: if we did something about education we would not be facing many of the problems societally and individually we would be faced with otherwise.

Another reference, a more recent one is the Report of the FAST programme of the EEC. Some scenarios for the informatin society 15 years from now on were presented, and two major challenges to Europe were analysed. The unemployment, problem, and the loss of industrial competitiveness of European industry, and they surely are conflicting, those two objectives. If you want to do something aobut one of them you do something negatively to the other one, and that gives political conflict. I don't think one should, let's say, reduce the importance of, there is a trade-off, genuine one between the labour market which you need if you want to become industrially competitive and social security of one of the gorups, but that's where, I think education comes in. Education can reduce the importance of that conflict, that trade-off. Therefore, something must be done to education, something must be done to the educational system and there educational technology is an important element of the response. But I say again, referring to the publications I mentioned before, technology, the purely technological factors are less important than the social, institutional and political forces in our educational system.

After this general introduction, let me turn to educational technology. There I think I will agree with all the speakers wo have already been discussing educational technology. What's available, hardware, processors, fast reliable, small and cheap, I won't go into that. We have got very high capacity, some very reliable, they have become cheap. I don't see hardware as being a bottle-neck for what educational technology can provide. The solution to the problems in education, its either in software (I've distinguished between the software and the man-machine interface, although they are essentially the same thing becuase they are both related to software) but I would like to put particular emphasis to the man-machine interface.

I think the main bottleneck in education technology is in the machine and machine interface. Well we certainly have seen a lot of progress over the last five years, in colour-graphics and quick response and other apsects, but we still require a high user discipline and harder education, higher qualification, high skill of the user. Although many of the systems that pretend to be dialogue systems I don't think they really are, because I don't think you can have a dialogue system if you don't have a model of the user at the other side of the screen. A model of the user which includes all his idiosyncrasies, tries to understand what he needs, why he behaves in the way he does, why he asks that kind of question and what kind of information he really is looking for. I think this is where we have the bottle-neck from a technological point of view. If we want to have a man-machine dialogue then we need a model of the user in the machine. I think we need elements of knowledge-based systems, artificial intelligence. (There are so many terms around essentially defining the same thing.) You really need an intelligent man machine interface, and that's what I would like to put for the consideration of this project team that though there should be a key element for what could be done, what should be done in relation to education technology, but then comes the important thing, and there I think I would disagree with some of the previous speakers.

What should the EEC do and what could the EEC purposefully do in relation to education technology? I don'pt see any significant role at all as soon as we talk about the education end of it, as soon as we talk about the customised courseware end of it, because the EEC and the Commission of the EEC just haven't got the means, the tools for being effective. Let's say, you're very close to the user needs in general, and then when you talk about education systems where each of the Member Countries has got a product which is unique, which is result of the unique historic and cultural development of that country, I don't think EEC could do something purposefully. No, I think it should be on the other end, that's way I put the technologies, say in a different colour. There I think that the EEC could be very useful and could do something which could not be done on the national level, following the model of the support the development of technologies for education. There I would suggest the two which I've already referred to, intelligent man-machine interface for courseware, and courseware based on the knowledge-based systems techniques. In that, I'm in accord with several of the previous speakers, but this one is I think a point I would like to emphasize and I would like to put for the consideration of the project team, its a point which you need to discuss, where should be the EEC put its emphasis in this rather wide spectrum of possibilities going from future needs to basic technologies, important to education technologies. Thank you very much.

Question

Would you include the suggestion that Mr. Breukker has made also into the topic of technology constructing such basic systems for courseware construction?

Mr. Holst

Yes, yes I would.

Question

Where would you get the people with the artificial intelligence or knowledge-based systems skills, because there is tremendous competition for such people?

For example, only last year the Alvey programme in Britain has been specificaly inviting, applications for people to work on intelligent computer assisted instruction, they're getting none, because everybody in fact is working in robotics or manufacturing systems.

Answer

It seems a very real problem. I think over the next five years you'll see a difference because you will see a number of graduates coming out

of the universities this year who have been studying artificial intelligence.

Remark

Its very dangerous, because if you do expert systems badly, then you end up with amateur systems.

Dr. Laurillard (Open University, UK)

I'd like to offer a reply to the question, which is that we shouldn't be getting these people at all because the proposal is too ambitious, certainly in the short term, to try to develop systems which require knowledge-based systems models of users and such like. Within education this is an incredibly difficult thing to produce, not only because of the artificial intelligence side but also because of the limited understanding we have of learning and knowledge and so on. Its very very difficult, it seems to me too ambitious.

Mr. Holst

I think it might be important to make a distinction between say, what kind of activities should be done on different levels but personally I believe that there is a very important distinction between what is more usefully done on the national level and what is most usefully done on the EEC level. I don't think anything beyond a time horizon of five years should be considered at all within the EEC because it hasn't got the infra-structure for doing it, it hasn't got the infra-structure for let's say, exploring the results of it. If you consider a time horizon of say, five to fifteen years, I'm not that pessimistic concerning the expert systems, artificial intelligence, KBS-based techniques for education technology. I completely share your concern with what could be done over the next five years and your concern for getting the staff for it, but any suggestion you might make here, you won't see let's say, a Council proposal or an action taking place before let's say, in 2 - $2\frac{1}{2}$ years time. With that time horizon, I think, things will have changed a bit.

3.4 Mr. B. Lang (Belgium)

Ladies and Gentlemen, I speak to you this afternoon as a practitioner, as someone who has spent the last three years within the courseware side of developing educational and training programmes, using a combination of newer technologies, and essentially I've been heavily involved in disc and computer hybrid systems. What I want to do this afternoon is quite specifically give you some experiences I've had in using different combinations of technologies and then simply reach three conclusions which can act as forms of advice or as suggestions

to how the EEC might structure its involvement in the development of education and technology.

The first thing we started to do three years ago was ask the question: what is trainings greatest need, and we came up with one simple answer, which I think has been addressed in some of the other presentations today. Some way to reproduce the training functions so we can basically package it and distribute it. There are very limited numbers of skilled trainers in the world and up until now its been impossible to reproduce those trainers electronically if you like, in such a way that not only information of the training process but the process itself can be distributed and used successfully in a distributed learning process. So that's what we set out to build and within that context we analysed the contents that we wanted to include in some kind of training device. Essentially, it is the five elements of information that you might find in various combinations of existing technologies. The problem until recently was finding one medium, one system to combine all of those information sources economically and in a way that we could control with courseware, with programming, call it what you like.

There have been a lot of terms mentioned today about CBT, CAL etc., essentially, it is about how you deliver a training programme to the end user that he is motivated to want to use. Here is a key word which I think really sums up where the technology is going. Previously independent technologies have been used to a moderate degrees of success in different areas of training, now we're getting to the point where we can snatch TV and put it on video-disc, we can take main-frame computer-aided instruction, put it into micros, we can offer human interface techniques such as touch screens, mouse and voice and begin to converge those into one system.

Let me show you a picture of one such system which is a reality, its something we've developed for IBM. This is a very early prototype but essentially you can see that in the corner here is a video-disc player, we have a microcomputer here which in this case is IBM, and we have a special monitor that behaves in very similar ways to the IVIS system that was referred to this morning. A single monitor has four technologies converged into one unit: it is a TV set, it is a high resolution computer graphics terminal, it enables you to overlay new information, or changing information on top of fixed background video disc images. Let me tell you, we've discovered at least seven new ways to interface with the user by having a combination of images on the disc which you can't change and overlaid information which you can and you control the whole thing by touch.

That system in reality looks a little bit like that, I'm just putting this, if you like, piece of adertising up to show you that these technologies like Ivis actually exist today. People are attempting and do have real experience to offer in the use and the failure of trying to combine systems to produce an effective educational technology delivery vehicle. Now, to make sure we continue the practical theme, let

me give you some costs here, and I have to admit I'm afraid to a total ignorance of the current value of an ECU, so I'm going to stick to US dollars which I think is the next universal currency that we might all understand.

Take the three elements which I think we need: We need computer-aided instructions, we need a colourful, pleasant, easy to use output device, and we need a cheap storage of massive amounts of information which can be data, voice, audio still images, movies - everything we traditionally used in incompatible technologies from slides, foild, video-tapes and films. The CPU must have communications to talk to main-frame machines where you have much smarter artificial intelligence or knowledge-based authoring languages that can download elements to this individual monitor. You need within the monitor the ability to show a variety of sources which is not just computer graphics, because even the nicest computer graphics today do not compare with a nice picture. If you want then to compare slightly you're using enormous amounts of computing power and that's still expensive, relatively speaking. So you should be able to show computer graphics in the form of RGB output from tape or disc. You should be able to drive it in a way which complements, not necessarily replaces the keyboard, and I personally believe that touch-screen is one of the major ways. You should have anoverlay capability to associate changing information, which may also be different language information, with common images coming from, in this case, a video disc. Then you need the disc player.

Now that is 8 thousand dollars is todays price if you want it to buy that technology that I just showed you, from our organisation. Now, if we go to a lower end and if we change some of the functions and features, we could build today, not just us, but anybody else with the know-how that kind of capability in a traing educational system, for 2,800 dollars. If you take the trends that are happening today and extrapolate them, not five years but less than one year, we can offer the same function for 1400 dollars. And you noitice we've gone from three boxes to one.

Let me summarise. I'm going to give you three messages based on my own personal experience and again, these have been emphasised quite well today. Let's not worry about hardware, as Mr. Holst said; that can happen, people can make wonderful things, if you want an anti-gravity machine give us 12 months. Hardware is not the issue anymore. However, you should also understand now that software is not just clever computer-based authoring languages. It is software that has to motivate people, it is software that has to get the fine balance of pretty pictures on a disc, stereo-phonic music to reinforce the message, animated computer graphics, touch screen to give the user control. We are used to having, if you like, musicians who have been composing up to now for a piano to have one instrument with eight octaves, and they've squeezed as much harmony out of that one device that they possibly can. Today we're asking those same composers to compose training programmes for a whole orchestra of training instru-

ments that we're combining by converging technology into one system. This requires new skills and new approaches, that's where I think the emphasis should be in the EEC, as indeed Mr. Camstra has said. And finally, let's not get hung up with hardware and software, let's remember the human training function because technology in its own right should be an aid, if it is sensibly integrated into the way in which you want to train people as my concluding image just to summarise that point. Let's not turn the trainers to stone through technology, let's work out a human interface that complements both sets of skills. Thank you.

Question

I wasn't quite sure how you got your last row of figures. I didn't quite understand what you meant by saying you could now produce a box by the end next year, for 1400 dollars.

Mr. Lang

Six hundred dollars today in the UK buys you a machine called the QL which essentially has more function that the same box that we're quoting here for 3000 dollars - the IBM PC. We can extrapolate that quite easily and say we don't necessarily even need the QL's capability if we have a communications function and we share much higher functional central machines, whether those are in-house or on local area networks or on telecommunication lines, so we can bring that down to 300 dollars. We have used 300 dollar micros to control video-disc players to give us most of this function.

Question

You're assuming then that the intelligence will all be in the computing - not in the disc player?

Mr. Lang

Yes. I just want a slave unit that reads pretty pictures on a video-disc, and if I can record on it even the better. You could buy, for instance, the new Pioneer slave machine which still has its own box and its own set of buttons, strip those away, put them in one box, you can easily get down to 400 dollars.

Question

There was an unfortunate constrast between what you said and what you showed in the picture of the wonderfully complex combination of different media. It was being used to ask, of all things, a multiple

choice question, which for me underlines the importance of what you said, which was what we need now is much more sophisticated software, more sophisticated man-machine interaction which a number of people have been talking about, the reason for that is that that was developed with some kind of authoring system.

Mr. Lang

No, that' all the baisc programming, but that just proves the point, you give the designer this super set of boxes because its totally new to him and because its totally new to him, he's going to use it in old ways. That's where the emphasis should be, skills in using this educational technology which, as Mr. Holst said will come, there's no question about that.

Question

I'm only wondering how you're going to squeeze the software into the 64K becuase the basic interaction software is huge in relation to the direct courseware, or what might fit in afterwards for the direct application.

Mr. Lang

Two comments immediately: one, 64K I put up just as a reference that I think most people understand. Storage is not an issue. Secondly, I think, with respect, you still are relating your current trditional approach to computer-based training where you're using all the interaction as logic in the computer. I could mention seven new ways that I referred to where because you've got a touch-screen and you can overlay, in other words, associate fixed images with new information. You can reduce considerably the need for clever code to achieve the same objective.

3.5 Professor le Corre (France) (Translated from the French)

To get to grips with all the different authoring systems, you can try to classify them. Dr. Camstra gave us an example of that a few moments ago, and I think this should be looked at in more depth in certain points. I agree with, basically, what he said. I think one has to look at what an author who is not qualified in data-processing can do in the way of giving instructions. Very often he'll give the instructions according the message which is too rigid, and lead on too rigid teaching strategies. You've got a lot of methods, all laid down in different ways. First of all, you're going to have to take account of the functionality, and whether you are going to have access to that, or the actual instruments which will allow you to use the functionality.

I've got a survey here which was carried out in an American Insurance company on questions that have to be asked, the kind of questions that we need to answer in order to define an author system. We've got five very concise pages here but its still not very full. First of all, we've got the hardware part, that's the background really, and then the possibilities of standard software used for other things. Then you've got the CAL itself and then the CMI (Computer Managed Instruction) and then you have the documentation. What you could achieve, what the possibilities are in terms of compatibility the costs and other general aspects? Now in order to understand it, I have based myself on some work by Kearsley, which has already been mentioned. I have tried to give you, in the form of tables and charts, a certain number of examples of these authoring systems. This is what I've collected, what I have main information on and this is fairly recent.

In black you've got the name of the system, then the year, the latest version, whether its '83 or '84 for example, that's very often the first version, and then you have the price in dollars. Now this is contestable because the idea of actual power should be defined, also usability. I didn't have any space at the bottom, but I could have added the hundreds of authoring systems and languages that can be found. They can be found in use, or in the different laboratories that have opened in the last 15 years. The interesting thing is that on those systems which I had information, if you ask what the functionality is, the kind of functionality that's specifically indicated, sometimes the answer is fairly modest. Nevertheless, some of those systems can be interesting, despite those first impressions. To give an example here, it is very irritating if you're doing computer-aided teaching, not to have access to a random number generator, though you will often not have a system which will allow you to for example, use slides on a video disc, so you've got a restriction right away.

Then you have the problem of characters of different sizes, variable sizes. In fact, as everyone knows, this is of major importance and something I've only realised recently - you might have a message that is difficult to get over if you can change the size of the characters, if you can vary them in size. This is the question of presentation of a message on a TV screen or video screen, that is absolutely fundamental if you're going to use computer-aided teaching effectively.

(from transparency) the red bit by the way is what is missing: you don't have the graphic, or sound, you don't have the connection, the video tape or disc. What is marked in black, is compatibility, the compatibility factor. I think that now in the United States almost everything is compatible with IBM PC. Exceptions are marked by asteriks. Then you've got highlights as well without colour, there's the '80's, Single-user Pilot as well, there's the Plato but that can also be on the IBM. Now, Phoenix you have as well which is not compatible with the IBM PC. So as I was saying, I marked in red, what the system doesn't have and I'm trying to superimpose on all these things, where you've got colour-graphics, link-up networks, sound,

video disc, video tape, loading to a larger system or the opposite and then the variables. I'll take away the red parts in a moment, try and make it a little bit more legible. The horizontals, that is the usability basically, classified in this way, about 6 or 7 different levels involved, but as I said, there are a lot of people who don't agree with this. I put in certain systems where I had a bit of space on the page, but we didn't have enough clarity and definition to put in everything. Now of course many of these systems are very expensive and in any case, we need better definition, animation is what its called. Certain systems will allow you to implement this, some of them are recent systems, the Mach G something which is there and TICCIT which is very good as well, and there are others as well, which I'm not very familiar with like the simple Pilot. RTG as well, random test generator, now there my be I could have included other systems but I couldn't find them in all the documentation. At any rate, some of those are very useful instruments.

You follow the characteristic of the particular student, a lot of systems to this but they don't explain how to tackle it. You've got further possibilities as well, so-called back paging, I don't know which other systems have this. Re-start as well, so that if the people stop at a particular point, they can start again from that point exactly, the same point in other words. The touch panel and so on, those are indicated as well. One point, and more recent, is the graphic possibilities plus text, you've had an example of that already. The best example I know is the TICCIT system which gives you pictures, images, graphs, or the text which you can superimpose on it, in fact the graphic part is of very good quality. I do not think we can make any proposals on the system that we would like to see used, or we would like the Community to use. We can't do that until we have a much clearer and fuller picture of what is available, taking account of functionality aspect, what should we actually opt for. I think 'everything' would be the answer to that, but that is not enough. We have to go into much more detail, and see what each one of the functionalities will give us, what the different manufacturers can provide if we are to think up a new overall system. Thank you.

Question (interpreted)

Is the authoring system going to be used by teachers, school teachers for example? What are they going to do if they don't know how to program? You've got that on the one hand and then the kind of system that has to be used in a centre where they're using a lot of courseware with professionals, that's the other end of the scale. We have to assess systems in two different ways. It depends very much on the use we want to make of the system.

Answer

Yes, I quite agree with you and I think that's quite right. In fact really I should have said this myself, because there are two levels of

authoring systems. First, for the teacher in school, and then the other system for the sort of major centres, plus two types of micro-computers, authoring ones, large scale systems, and then the cheaper model used currently in schools. There is another thing we shouldn't forget and that is that the new information technology is on the increase, specially in introducing it into companies in industry and that helps us in terms of actual national education as well because of the drop in price. Then there's the question of compatibility of what had been done in the company. We are not trying to compete there but I'm very surprised to see how the situation has developed in terms of computer-based training in the United States and that in a matter of months. I was at a meeting in Chicago last year, there were 500 people supposed to come along but 1000 did and half of them had already done quite a lot of work in their companies, people who were really aware of the effects of teacher-based software. They were people from industry, basically, that was the major interest, and that is going to give a considerable impetus towards the use of new technology in national education, all areas of national education. I don't think we should forget this when we're trying to define systems so I do really feel there are two authoring levels, a simple one and a more complex one as well. Thank you.

SESSION 4 : Comparative costs of conventional & IT-based E&T

4.1 Dr. Akkermans (Netherlands)

Because my topic is so difficult I have enlarged it a little bit. I do not want to talk about the comparative costs of conventinal and IT based education and training but about costs of conventional and IT basded education and training but about costs of information, technology, education and training in general. I am able to do so because we just initiated a new programme i the Netherlands with a large five year budget, in total a quarter of a billion guilders for five years which is part of the programme comparable with the Alvey programme. The total programme involves 1.3 billion gilders over five years.

Well, of course, if you have to launch such a programme, you have to set priorities and especially financial priorities and I will give you the list of the priorities we have set and then we will discuss the problems which arise if you want to make a choice.

The priorities which have been set in the Government Programme are:-

(1) Demand of money of 25 million gilders - for computer literacy;

(2) Computer Science as a specialist subject, with a limited number of people, we want to allocate 20 million guilders in five years;

(3) Applied Informatics to a broad number of people especially in vocational education also information technology and machine technology; over one hundred million guilders;

the priority for computer-aided instruction is quite low.

Added to these priorities which also are specified for educational sector, we have some overall priorities - I do not want to get into detail here. Infra-structure for course developments which will involve physical network - 40 million guilders. Inservice Teacher Training - 45 million guilders - you may say that is too low. Education and Research - 10 million guilders. That adds up to the amount of money I gave you.

Well the problems you have in setting priorities in such a programme: first, you have to weigh all the arguments relating to the comparative costs of conventinal and IT based education and trianing. That is the topic which was the formal subject of the talks against short term economic needs which come from completely new educational objectives - the first thing I mentioned related to how can you realise by applying information technology the same educational objectives involving new technology. If you look to the low priority for computer-aided instruction, you see that realising with new technology, the same objectives has got a low priority relative to realising new objectives. I want now to go to my second sheet. That is the problem which is best formulated by algebra - cheap things x many schools is big money. That is one of the major problems you have to deal with if you want to formulate a programme which, in principle, touches the whole educational sector except university education, which is excluded form the programme.

It means, because it is such an enormous problem, that you have to choose, on the one hand a strategy towards all schools with cheap technology or on the other hand looking for pilot projects or an in depth not expensive strategy which prepares you for future technology. But you should have in mind the political pressures very often push you to the first priority instead of the second so you might very often, even with good arguments, have to go to the second strategy. All kinds of linguistic problems occur especialy in teacher training; that is the reason that the budget still relatively low - you would like to give the higher priority but it is very difficult to start such big programmes when linguistic problems occur in the whole programme.

The problem is how can you enforce the bargaining position of the Government especially the Minister of Education in buying hardware, courseware etc. Another topic is how can you enlarge markets, becuase if you have a larger market, you can get a lower price and it means that, in fact, the budget which the Minister of Education has to pay will be lower (at the end) or the number of pupils you can reach will be larger.

The last topic is how can you involve other financial reosurces, other than the budget of the Minister of Education. Well, of course, you have to look to the Minister of Industry or to the industry itself. We have seen programmes, especialy in France and Britain when a Ministry of Industry did get involved quite heavily. The involvement in Holland, at the moment, is 75 million in a programme of 250 million

which, of course, for a civil servant of the Ministry of Education is still too low.

Well, I want to give a few examples of that problem of cheap technology times many schools is big money. First an example, they still only have 85 schools. If you look to micro computer control machines in medium level vocatinal schools and you look to the proposals the schools made themselves, you get enormous budgets - 85 schools what they want ot have will cost you half a million guilders in a total that is 40 million that is half the budget available over 5 years. Of course, you have to look for a way out. You can limit the number of schoopls but that is politically very difficult and, therefore, we look to other strategies and the first thing I want to put a lot of emphasis on is the stripping of certain technology after you have very clearly define you educational calls which is a very time consuming exercise because you have to bargain with industry which can make the technology and you have to bargain with the schools and in the educational fields what do they need, why etc. You can bring down costs by a factor of five, then you can buy items for hundreds of thousands of guilders instead of half amillion. There again you look for co-financing especially vocational trianing is concerned you look clearly to the Ministry of Industry and you should try to realise collective purchases if possible and buy things for the 85 scghools at the same time. Well a second example, whre you have still much more skills. In all the schools the pupils are from 12 to 18 - in the Netherlands it is altogether 6,8000 schools - well if they all buy a day to day management packet of their own, which some people say is educational freedom, they had to pay 6,800 times 2,000 guilders is 40 million guilders and then still they have to copy it illegally within the schools - you should also strive for collective purchase and bargin. I want to emphasise that bargin in those areas where the market is not only the educational market but also the professional market, that you can realise by bargining against 10 per cent of 5 per cent of the market price simply because sellers have in mind their own long term benefits and accept that they have no profit at all within the educational field. If is much more difficult in those cases where the educational market is the only market so if you have courseware which is only developed for the educational markets and then its bargin mechanism works much less favourably.

For the conclusion, I wish to return to my second sheet because I want to indicate where the Common Market - the EEC give priorities to and I think it is a bit in contrast to what many other people have said earlier what I indicated in red here should be priorities within the EEC, it should focus a lot of attention to getting cheap things for education for which we have defined educational goals after that long process I talk to you that may involve sophisticated technology but not necessarily a second area where the common markets can be a good thing. It is to enlarge markets. For example, in vocational education, you have to develop specific things for an area where you have 85 schools, you can realise economies of skill by doing that - with more countries together were exchanging package you have developed in

the Netherlands by a package which is developed in another country. I also want to indicate a blockage by theEEC because our Minister of Industry stated that it is not allowed to finance developments which are broadly directed to industry because it is forbidden by the EEC because of competition reasons and I notice always that these reasons are not put forward in France and Britain and I always hope that the next Minister of Education in the Netherlands will leave those arguments aside as well.

4.2 Dr. Chris Curran (NIHE, Eire)

I am very glad to have this opportunity of participating in these two days. My subject is rather particular, it is economic aspects of small distance learning systems, and might at first sight appear to be irrelevant, and may well prove to be largely irrelevant to the interest of most people sitting around the table here today, but it seems to me to have some relevance. First of all, because distance learning has considerable potential to reach a wide audience, particularly those who are at work, and possibly also it may be more amenable to innovation than some areas of conventional education where there is often a certain resistance to change. Secondly, why small systems? In particular, because many of us can only afford small systems. We can't afford, for instance, something of the scale of for instance the UK Open University, and also because we could argue that small systems ought to be more responsive, certainly more flexible, less bureaucratic perhaps than the large costly system. So, what I wanted to say something about then, was the economic aspects of a small pilot system we've been involved in.

Now, we have been very interested in the economics of distance learning, since we got involved in this programme, just over a year ago. There are two issues that seem particularly important. First of all, the comparative costs of distance learning vis-a-vis conventional systems, and secondly what would be the cost effectiveness of particular media, and I have to say at the outset we haven't successfully answered either of those yet.

Both of them of course are related to information technology, the second directly so, we obviously looked at the research that was available. Many studies are now available, for example Wagner on the Open University, Costa Rica, the World Bank studies and so on, which had demonstrated that particular systems, distant learning systems have proved less costly per student than conventional education. Now there are quite a number of qualifications, but it seemed to us that there was very little available on small systems. There's the well known study by Daniel Snowdon, and there are some studies from the UK by Birch Cuthbert and so on, but basically there was very little that we could get our hands on. In relation to the application of information technology, apart from the work of our Chairman, there is relatively little available. Some studies have been carried out for example on broadcasting, a recent study in America by Louis has shown the range of technologies used in distance learning, in systems ranges from about 50 to 36,000 students, and generally the results of those are fairly broad. They suggest, for example, a decline in the use of broadcasting and an increase in less complex systems.

So what I propose to do is to talk about is a course project we have had, and the way we approached it. This particular course is part of a pilot project which is a precursor to a national programme in distnce learning. It was run so that we could find out, answer questions like - would we get co-operation from other institutions, will there be a demand etc. etc.

The three principles we were given were first, that the programme should be relevant and in particular, should look at areas like the need for recurrent education. Secondly, that it should be co-operative, that we should seek to co-operate with other educational and other institutions, and thirdly that it be cost effective, and specifically I want to say

something about that. In relation to this particular course, that involved capital sharing, and as you may know distance learning can be a very complex exercise on a computer based system, and buying in and adapting a text. We were asked to see what the long term implications would be.

Very briefly, the course we selected was one in computing. It was essentially an introduction, essentially concerned with programming and the elements involved were broadcasting, 11 programmes for broadcast with the National Television Authority. It involved a learning pack, the core text was brought in weil and we had to write about 25% of the pack. One of the interesting things about computing was the range of computers: we had to prepare 6 different packs. These were problems as we were using different machines and these were people who were not familiar with it. Tutorial support involved the usual monitoring of assignments, there were 9 or 10 assignments, attendance at centres and day schools. We ran 3 groups with students, some with no access to centres, some with access and others with more access to see what the results would be. The studies centres were a very important part of the programme.

We had about 1700 people on the programme and one of the interesting things to come out of it was the very strong work relationship. The dominant reasons for coming on the course was to either develop skills in the present of future job. People wanted to know about computing, and that seemed to be a very strong thing. It also came out that the people who remained committed to the course and finished were those who had a strong work motivation. The study centre network was extremely important, and as I said the idea of co-operation was fundamental to it. We provided a fairly extensive network of study centres, on a co-operative basis, now this really was quite a low cost way of doing it. The study centres were in places, ranging from universities to local community schools, and also in industry and in public sector and so on. We deliberately ran quite a range of them, including prisons and rehabilitation centres.

We provided one computer to every 2 the centres provided. In the case of the centres in industry the proportion we provided was very, very much less, so it was a way of cutting odwn the cost involved in mounting a programme of this kind. Now one of the features of course of distance learning, is that it's very complex. This in fact was a very complex programme to run because it involved learning packs, day schools, contact with tutors, phone contact with tutors and so on, and all of that had to be organised. It was done by a very small course staff, in fact of 5 people, 2 of them were academics, supplemented with part-time staff as necessary. So it was necessary to manage the entire programme by computer, and we had a database programme which we ran on our main frame VAX, to which we had access in may own institute. This was quite complex because we had 26 centres, each centre had anything up to 10 different sessions available, and each applicant gave a list of preferences to the times he would like to attend. Obviously, the sorting and so on had to be done by computer. Similarly, all the sessions, the allocations of the computer, the control of the computer equipment and it's maintenance and so on, everything in fact was computerised. And in that way it was possible to contain the costs of the programme fairly tightly.

Now very briefly, did the programme work? Well, it was a very detailed evaluation, by external consultants on the programme. One of the issues which arose was whether the programme had met student objectives. By and large, students had strong work motivation: about 12% were managing directors or company owners and about 25% were professional people, engineers and so on, involved in practice, and about 14% were involved in teaching of one level or another. In general the response was that it had met their objectives. With regard to providing further programmes in this area there as a very strong interest in this, and one of the most interesting conclusions, for me at least, was that the majority of students were very keen to study at a distance, because of the freedom. I won't go into a lot of the research but we found that about two-thirds of the students came from areas where courses were already available, but preferred to take it through distance learning, presumably because of the convenience involved. What about the media used? One of the areas was broadcasting. We found, and I think this is parallel by a number of other studies or some research, that in fact as an educational tool national broadcating was of limited value. Students in general didn't find it that useful. But in terms of reaching out to the potential student, making him aware of this technology and convincing the student that this was for him, it was enormously powerful and that seem to be to us the areas where we would expect to use television in our main programmes to reduce the very heavy cost involved. With regard the use of computers as I siad we were able to minimise the cost there by having capital sharing with the public centres. With the home students we found an enormous variety of machines, well over 20 different machines and this gave real problems in terms of their adapting to the course. Also, many of them didn't have the keyboard skills and so on that we anticipated the home students would have had. They were much less successful in completing the course than the students who had access to study centres for 15 weeks. With regard to phone communication, it was hardly used. Less than 3% of the students rang tutors and we have had to devise quite new procedures in that connection for the programme which will be commencing shortly.

Our future plans are very interesting. We have introduced electronic mail within the institute, we're interested in extending this to our centres so that the management of the programme, attendances and so on can be handled. We think also that there is a possibility also for assignment monitoring and that is an area we are looking at. In summary, the conclusion which generally came out of the external review was that there was an extensive demand for courses of this kind, that there was a strong work relationship, that distant learning had proved a relevant mode, and that a low cost extensive programme was possible, using an existing infrastructure, locating the dewelopment within an existing institution, adapting a bought-in text, which I don't think is essential but is helpful, very strong promotion through radio, TV and so on, and the use of computers for administration.

Question

Could you tell us a bit about the bought in text, particularly was it designed for this sort of usage?

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Dr. Curran

It was a distance learning text designed to introduce somebody with no knowledge of computers at all to computer programming, and we developed it because we felt that was rather specialised, we rewrote part of it and we added about 25%, additional material to it. It was developed by the NEC in cambridge and it was in fact selected by group and we ran with it.

New speaker

4.3 Mr. M. Jensen (Head of Department in the industrial division of the Danish Engineers Postgraduate Insitute in Denmark)

I would like to speak very briefly about information technology in post-graduate training, and to that end I have to tell you a little bit about our organisation, which is called the Danish Engineers Postgraduate Institute. It is really a continuing education institution and we are involved in management training, for different subjects, engineering, covering nearly all engineering subjects. We run approximately 350 courses per year, lasting from one 2, 3 days up to 6 weeks. We have approximately 7,000 participants per year. Additionally, we run approximately 100 courses per year, in-company special tailor made courses, in many of the bigger Danish companies. We have a few international conferences also. Our participants are mainly senior executives, junior executives, technologists, which means that they are mainly with an academic degree. They are from engineering, biology, maybe a few from economy and a few from the management training schools in Denmark. They come mainly from industry, few from commerce, or services, from banking and insurance, and a few from common institutions. We do not lecture ourselves, we have a staff of 30 permanent people. They are engineers, psychologistys and economists, and we draw for our lectures from the public sector, which are experiment centres, trans-network organisations, private and government enterprises as well as other organisations, and we have approximately 800 lectures per year. Well that is the organisation.

I admit one thing: I am a computer enthusiast, but, I am also very sceptical about it. We have tried to act as a sort of information and arrangement centre during the last few years. We now have a yearly teleconference, we have a one week courseware development course, we try to complete their CAL guides and are doing extensive evaluation of external courseware, uisng computers which are mainly in-house. Having said that, I have decided tomake one point, and that is so far no information technology technique has superseded or replaced traditional teaching or practice. That is an over-simplification, but here the problems. The first one is the poor quality of the courseware. The second is the expensive development cost, combined with a lack of flexibility in relation with the varient amounts from the companies. I have now got a few typical cost figures: it costs us approximately 800 ECU, to develop a course. As well as development cost, and a course has a lifetime in a certain category of 3 to 4 presentations. In management the courses are revised with approximately the same rate of frequency and there the revision cost would be in the order of 600 ECU. The typical fee for participants is 125 ECU per day. We do not

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receive any subsidy from the public, this is maybe an exception in Denmark, but it also gives a very good idea what is the cost of developing courseware and what sort of cost are the other gains if we want to introduce more technical information in the future.

One thing of interest could be, that when we say, that it costs participants 125 ECU per day, the fees in a public school would be approximately one tenth of that. With so little repetitive training it is really prohibitive for us at the moment to exchange part of our curriculum with computer-based or the information technology based courses. However, we know also, at least we would guess, that in 5 to 10 years every engineer would have his or her terminal and it will be just as normal to pick up information stored on a disk as to take a book down from a bookshelf. That has led us to investigate how we can fulfil this need. We have a sister company which is a publishing house, one of the biggest publishing houses in Denmark. They of course have some of the same interest because they see the book to be replaced by the disk. So the question for our organisation is when and to what extent should we start to develop our own courseware, and the problem is the variety of machines. We have done some initial experiments but we have not been able to find a general solution to this particular problem which we think is maybe one of the biggest ones at the moment.

So, there are only a few areas left, one could be the retraining of previously unemployed engineers, although at the moment there is only a low unemployment rate for engineers in Denmark. It could be that it would be necessary in the future to bring engineers up to a certain level, in a company, or before they can attend one of our courses, and there I could see some possibilities. It would certainly also help some interests, when we talk about retraining engineers, who have not had computers or data processing in their first training. These are the only 3 areas at the moment. There have been some other thoughts in Denmark on this subject: in the area of Aerhus, which is the second largest town in Denmark, 5 companies were introduced to the PLATO system, and 2 of them came up in favour of expanding this? In business schools there is a quite extensive network of different technical institutes. So far they only use the telephone line for communication, with the sort of information which they can exchange with one another.

New speaker

4.1 Dr. G. Pangalos, (Greece)

I hope you appreciate that it is difficult to comment about comparative costs, for the very simple reason that we don't use much of the information based technology in Greece. So what I will try to do is to give you a very brief account of the environment in Athens, then make some comments about the parameters of the course involved.

Regarding the general picture of professional education and training in Greece, we cay say that very few companies or organisations have their own training departments, in that sense professional training is centralised

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and its offered in most cases by specialised bodies like ELKI power and other organisations. This organisation uses part-time teachers in most cases, and as I have said before, they make very limited use of modern information technology. If we come to our centre, one of the main objectives is educational training, aslo it has other things like consultancy, maintenance, servicing and data processing etc. Our centre covers many places in Greece, and I would like to give you a brief account of what we are doing. We offer something like 80% of the total profesional education in Greece. We employ over 1,000 teachers and we train over 10,000 people every year, so you can see this is the main area where we teach people. There is over 30,000 hours total, and we have over 300 seminars. For this, 60% of the people come from the industry and the rest come from government bodies, services and the commerce. It is intersting to see that types of technology we use today to facilitate our seminars. Of course we use computers, main frame and micros, and we use them for practical training. In computer aided instructions we only use managment games. We also use video studios, micro-fiche film strips, projectors etc. We also use computer networking, to keep in touch with the large databases abroad.

We face some problems, in the use of the new technologies. There is a lack of information and potential users of the new technology, technologists, there is a lack of teachers or experienced people who will use it. There is a lack of equipment and of sales representatives of this equipment in Greece. There is a problem of funding, and of course confidence on the new developments on behalf of the big companies. What would be the future requirements of such an organisation of ours, or in general in Greece? First of all we would like to see wider use of existing technology, a development of national networks for data transmission. And use of new technologists for distance teaching like teleconferencing, video text services fascilime transmissions etc. Because of the geogrpahical characteristics of our country, we are far from Central Europe and the new developments.

Now let me tell you about the cost benefits. The way we see it, about the cost of training in education, there is not direct way of measuring the costs or related costs, because they depend on the direct financial costs, the quality of training you get in each way, the effectiveness and co-ordination problems, and whether you can do it or not. The cost is important in our case because we have a very large number of small, medium and very small companies, where they have a limited budget. Their use of information technology will make training available to more places around Greece. If we come to the related costs, I think with these new methods we'll have cost of equipment, cost of software, development of software, or using software, and the cost of the courseware. I think costs could drop in as far as hardware is concerned, and through the standardisation of the equipment and large scale production propbably at European level, for example, by producing special-purpose microcomputer chips or equipment. The software will become cheaper as more and more installations will be using the same software. Also we could utilise Community help and this means financial help in the first instance to help to co-ordinate and also EEC legislation against piracy in Europe and unauthorised use of the software. One final comment, the way I see it, I think that these 2 curves govern the cost and the time. The cost as we have experienced it of

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offering traditional education goes up. I'm sure that the costs of using the new information technology machines take professional training will go down.

New speaker

4.5 Mr. V. Thompson (CET, UK)

There is a notice in my hotel room which if I remember rightly suggests that the happy hour commences at half past five, since as the last speaker I don't want to encroach upon your opportunity to be happy I will be brief. I will also be brief because this is an area in which I am no expert, but my impression and I think it's confirmed by a literature search that we did before I came here, suggests that there really is not very much to go on yet, in terms of information about comparative costs of existing educational provision, compared with information technology provided provision. That's not to say that there is nothing to go on - I think it's reasonable to suggest that we have developed a number of useful techniques and methods for looking at the costs of education, but in order to do something useful with that we also need to consider the outcomes and the benefits. I think that is still a problem area. It is hard to reach agreement in terms of what the outcomes are and should be, and even if we can do that it is difficult to measure those outcomes. So I think this is a subject that needs to be approached iwth some caution. But that is not to say it can't be done. I have just received a newsletter from the University of Wisconsin teleconferencing project, and there is a report of a study, conducted by the office of day care services in the State of North Carolina. They undertook a project there and they say that the outcome proves to them that training via audio-conferencing is less expensive than traditional face-to-face training, and students learn just as much. I think we have to be cautious about that kind of report and looking at it we need to ask some questions. We need to ask who is actually undertaking the financial study of the cost benefit. Why are they doing it, and I think we need to be very certain about what the costs are they are taking into account, and what the benefits are they are taking into account. I think we can use the sorts of techniques to get some useful insights, and I'd like if I may to refer to a report of a project that we've recently completed. It was a project that was concerned with experimenting with the electronic delivery of computer software. It was making use of the public viewdata system in the United Kingdom, Prestel. What we did nwas to put a library of computer programes onto the system to provide some schools and colleges with software so that they could use their micros to access that library of programmes and to download programs should they desire.

One thing we looked at during that was cost comparison of telesoftware with standard distribution methods. I will just say a little bit about that because I think that is interesting. With regard to standard software distribution methods the costs tend to be proportional to the number of copies that are being distributed. Quantities produced, we found, for the secondary educational market vary considerably but it is not a very large market, and there is not much in the way of economies of scale to be introduced. The costs tend to be concerned with the producing of package, the

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cost of the disk and of simple documentation that goes with that. Publishers tend to provide a standard markup to cover other sorts of overheads. A markup of about 100% is average, and we get a cost of an educational package around about 10 sterling mark. However, if you start to distribute programmes via electronic means, via telesoftware, then the distribution cost is not proportional to the number of copies produced, but tends in fact to relate to the size of the programme instead, because one of the key questions in the amount of storage space, the amount of memory you need on the system to store the program.

So the sorts of costs we had to bear in running this system and putting programmes onto it were the costs of the persons involved in putting the material onto the system, loading the package onto the system and checking it was running correctly. We then had to pay for storage on the system, and then we had to find someway of providing the documentation. Then were then also costs borne by the customer, by the user because they then had to access the Prestel system in order to get access to that programme, so they had telecommunications costs to bear as well, a well as the cost of using the computer time on the system. We ended up with a cost comparison, and that suggested for an average programme of about 50K by standard distribution methods. We found that for 100 copies by conventicnal means it cost about 1,000. For about five hundred copies this went up to 5,000, in proportion, no economies of scale as I suggested earlier.

Now if you look at the costs by telesoftware, then we found for a 1,000 copies it was roughly about the same, 960, but the costs though were quite dramatically, for 500, just under 3,000 a difference of about 2,000 there. However, as I suggested one has got to be careful about that sort of information, because one of the other important things we learned in the trial is that elecronic delivery is only useful for certain kinds of software, so it would be a mistake for publishers to runoff and start trying to distribute programmes by this means. If you look at those costs a bit more carefully I think the other interesting thing there is that we see that there is a shift in the way that costs are met. So that in fact by electronic delivery the costs are just not being met by the publisher, there also starting to be met by the user. When I referred to 960 for 100 copies via Prestel, of that 960, 560 were met by the supplier and 400 by the user, so that 400 was made up of the telecommunications costs and so on. So there is a shift if you like of who is actually paying for the delivery of the materials. I think that kind of insight is useful and its that kind of insight that this sort of cost benefit analysis can perhaps provide for us.

Another think I would have mentioned really just as an aside, and I think it is a problem in the development of IT systems, and that is that you can't change from one system to another in one go because you can never get all of your users to move from one system to another in one go, or rarely anyway. So nyou have to run the systems in parallel and that obviously introduces additional costs.

I would say in conclusion that this is a very complex area, we don't know very much about it yet. It seems to me that information technology is

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generally a very complex area, and that we need all of the help from various disciplnes that we can get. There are some techniques here that may be helpful to us, but I think we should be very wary in making use of them because they only provide a partial view. In terms of what we are doing here I think that it may well be worth considering further whether it would be useful for Commission to support further investigation and promotion of methodologies in this area.

Question

What was the proportion of telecommunications costs of all the costs?

Answer

About, well it was 400 for the users costs which was just under 50% of the total costs, and about 50% of thai half would have been telecommunications costs.

SESSION 5: Future requirements, problems and obstacles

5.1 Dr. S. Cerri (Italy)

I divided my talk into 3 parts: first, eduction in information technology, so information technology as a subject matter. The use of existing information technology in information and training. So information technology as a tool to deliver education, and research on information technology in education and training, so IT as a method.

One of the things to me which is a little unclear in this meeting is if this meeting is organised to respond to a demand by users of information technology in education and training, or by producers or by both. I'll try to find out what the goals would be in the first, and the second and the third case, and I divided the people, the participants to this meeting into 3 categories (1) the users who had the general goal of producing better general education and training, more education and training and save money, (2) the producers who have the general gnal of selling more computers or services and (3) the scientists, or educational technologies who have the general goal of understanding teaching and learning, if they are more orientated towards education and psychology, or making intelligent teaching machines if they are more information scientists. And the question is are these conflicting goals? Are the goals of the 3 main groups participating in this meeting conflicting? There is a meta-goal of the meeting which I called the Meta Goal of making everyone happy. Users, producers and scientists and the users. To select is as a tool for delivering education, to make happy the producers and to select it as a method to make happy the scientists.

Is it possible to make this cake? Maybe it is possible, setting up or proposing a research project on the use of inforamtion technology for teaching information technologists. Teaching with computers has a couple of main modalities which were referred to yesterday. Either you can present the subject matter the student has to learn in a rich learning environment, such as for instance in games or simulations, or you provide the student with a set of tutorial dialogues. Actually an important proportion of education and training is based on tutorial dialogues. Actually an important proportion of education and training is based on tutorial dialogues. You can have important contributions provided by the use of computers, for simulating particular experiments or providing a fruitful rich learning environment to the student, but still this is an important proportion of education, which is based on dialogues. If this is true, if dialogue is still the main components or the main modality of teaching and training, then it is must be mixed with initiative, namely the student has to take the initiative, which was not always present in the traditional computer system learning programs. If the dialogue is mixed-initiative, namely student and teacher have to take the initiative, then the student could put questions and then the system should answer the questions, so it becomes a question answering system. If the system is a question answering system, then it should interpret the student requests, have a representation of the knowledge about the subject matter and many other things which brings us to consider these systems for teaching as well as knowledge based systems, they then have all the characteristics of knowledge-based systems.

Here there is a strong reference to knowledge-based information systems which are now becoming more and more popular in computer science. There

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are particular knowledge-based information systems, lets say co-operative and with a few other characteristics. This field of knowledge based systems can be called intelligent computer system learning and I refer to this happening in the future. The issue of user models is also very much present nowadays in research for the automated office. So I have provided you with two pointers to current research in computer science. Within the knowledge based systems research there are two main fields the constructional needs. The construction of environment for building knowledge-based systems and the construction of test beds for the validation of the environment.

The proposal concerns research and development for an intelligent authoring system which should be an extension of an environment for knowledge-based systems, including functionalities, components and tools, specifically for the design and development of teaching dialogues. In parallel with the research, should be a set of test beds of systems for teaching information technologies . What kind of information technolgies? The first one is the system itself, the authoring system, the environment or programming languages or the use of information systems. These test beds not only serve for validating the authoring system, but also for validating the effectiveness of the educatinal development in the information technologies.

I have a few constraints for this proposal which make it a little bit more well defined. The intelligent authoring system shuld include traditional authoring systems, exactly the same way as the environment for knowledge-based systems include traditional programming languages. Moreover, this authoring system should provide a slow transition between traditional computer system learning and knowledge-based computer system learning. Specific research issues should be author friendliness and student models, this should be portable and the product should be portable. So within this environment the user, the author, should define the target machine, which could be much cheaper than the machine where the environment runs, and the resources should be of a scale comparable to the ones for ESPRIT, a certain percentage. But possibly we could have intermediate applicable results on a reduced time scale. I have made a transparency to show a few more observations. Available CAI programmes should be made portable and this justifies the first statement, namely that the environment should include traiditonal authoring systems. There should be no need for immediate AI apprenticeship by authors, friendliness should be not different from the pwoerful programmers support in normal environments. The environment should run in a sophisticated machine and the product should make also happy the producers of inforamtion technologies, because it should be runable on very cheap but dedicated machines. Finally, a connection with ESPRIT is necessary although the outpus of the project could be gradual and intermediate results could be provided quite soon. The major obstacle for the research project, I forecast, will be the lack of trained people. It is a project to train people in this field and major obstacle will be lack of trained people to carry out the project. So this is a vicious circle and I terminate with a question. How can we break this vicious circle, provided we are interested in breaking it?

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Question

There's an interesting claim that you can make a smooth transition from CAL to ICAL, but I would have thought that ICAL, was quantum leap different from CAL. How could you possibly have a smooth transition between the two, they are fundamentally so different?

Answer

I can't tell you now in three and a half seconds how in detail, what I can tell you is that I believe it is possible and I could give a set of recipies for this. It is possible to think in terms of assertions and for instance rules, which are the basic constituents of an intelligent system, instead of thinking about data and primitives of a procedure programming language. It's not really a big leap in the head of a programmer, provided there is an environment which is rich enough.

5.2 Mr. John Duke (UK)

I suspect we have all taken different approaches to what we should say this morning. I shall be looking at the 1990's and trying to anticipate the impact of information technology on industry, the economy and society. Some of the impact is changing the nature of jobs and the nature of people's expectations of careers and working lives and therefore this impacts back again on the requirements for education, the requirements for training, both at that time and in the time between now and then. I don't need to go through any of these propositions in detail, but in fact an enormous change in fact is likely to come about. Not only as a result of information technology, but also as a result of other influences, which is going to cause enormous changes in our society, in the way our industries are organised, the sorts of industrial activity that takes place and therefore the requirements in fact for educated and trained manpower.

I did show yesterday this picture which I was suggesting will change the profile in fact of the manpower requirements. Now that in turn in fact is going to lead us to think about the impact on education, particularly in two ways. One is changing the products of eduation, i.e. we are going to need new curriula, new courses, new types of qualification, particularly to serve the needs of information techonology, and we are going to need new processes that will serve these new products within institutions to support teachers and to provide new sorts of resources for learners. Perhaps more importantly, outside institutions, and I am thinking here perhaps of new patterns for learning, obviously familiar patterns that are beginning to become available, open learning, distance learning, individualised learning, independent, these are all slightly different connotations, but in fact these types of learning activity are or can be well supported by application of nformation technology. So if we move in this way, we can see ourselves moving into an era where we have distirubted learning systems, which are not institution dependent. You don't actually have to go to a place to undertake your tuition, it can come to you wherever you

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are, whether you are in the home or in business, in an office or on a shop floor. The hardware, I suggest, is largely vailable or will become largely available, in the next few years. We can think, or already imagine these types of facilities available in the average household. Most of this equipment is already in many households, certainly in the UK. What is missing is the integration of this eqipment into a total learning system. So, therefore, I don't think hardware is a problem, and that's been suggested before. What is needed is work on systems that bring this hardware together; obviusly on the software side and particularly again knowledge-based learning systems that have just been mentioned, which I don't have to go further into.

Of course, those are going to be key elements of the new type of provision. Now what are the issues, what are the problems to be tackled? One is to integrate education and training. There is too much of a divide here, its an archaic differentiation. This is a continued spectrum, it has to be integrated. Education is a long-term business. It starts with initial school education and must continue to provide lifetime opportunity, for continuous personal development. Training is short-term and this has to be linked with the provision of long-term educational facilities and opportunities. So that's one issue to bring together educators and trainers.

Another main concern is to bring together academic interests and industrial and commercial interests. Again these are too polarised, again we must bring these together. Closer collaboration in identifying the growing objective, we need to set up sensible diaglogues between industrial and commercial interests, those that use the products of education and acaemic interests who are the providers of those products. We need joint enterprises in developing educational services and materials. There is insufficient liaison and joint invetment inproducing the right sorts of materials. Educationists try to do this as a almost alturistic adventure, relying on public funding largely. Industrialists and commercial interests are looking to make quick profits. Somehow these two approaches have go to be brought far closer together, so that we are looking for collaboratove enterprises where both partners are contributing, both partners are going to benefit from it.

Another issue is to bring together the concerns of public sector investment and the concerns of private sector. We need to develop a new industrial activity which can be an important component of national economic activities. We are seeing in Western Europe a decline of manufacturing potential and manufacturing competitiveness, and this is going to continue. We have got to replace this with some other wealth producing activities and one of these wealth producing activities could be the development of educational economic activity i.e. we have got to sell our educational expertise and know how to the outside world and in return from that we will buy raw materials, oil food and whatever from them. This is going to need contributions both from the public sector side, and I put here typical public sector institutions: obviusly the educators and the academic institutions, but also the broadcasting institutions which are still largely public sector national bodies and they do a lot or could do a lot more of work in this particular area. Already a large amount of resources are spent on

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educational broadcasting of one sort and another, but perhaps with very little effect, this has to be made more effective. And again in telecommunications, the PTT's need to be brought into the fold here and seen as contributors to this sort of activity.

Obviously on the private sector side you have got the hardware companies, you have got the software companies, the publishers, traditional book publishers who have to reorient their roles and key groups here the distributors, people like the local newsagent gets material to the public. I think getting material to the individual citizen is going to be a very key and necessary factor in extending this market. This came up sometime yesterday, someone said how do we extend the market for education? Well, there is a market for education its out there in the home, millions of people looking for it perhaps, not quite aware what they are looking for but it can be sold to them. So we need investment in a necessary infrastructure, we need a proper communications network, we need source libraries and databases which can be referred to and drawn upon, and perhaps most of all we need research and development facilities. Here perhaps we need something on the lines of the Manhatten project. Somebody said, where are we going to get all these AI people? Well, where did all the radio chemists and atomic physicists come from in 1942? The answer is if you make resources available then you will begin to draw people into a field. Educational research has been a very poor relation, it is not well organised, it is not well funded, it is a very, very individual exercise. There are no large teams or powerful institutions that can command resources, provide facilities and draw in as it were new generations of workers who are going to take the art forward. We have this in the sciences and the technologies in medicine, they attract young people into those areas automatically because there is status there are facilities, there is expectation. We have got to generate these sorts of facilities and this sort of expectation in an educational field. We also need policy determination, and tariff structures in relation to communications networks. We must get away from the system we have at the moment for paying for telephone time on a time-and-distance basis, we must either get straight to unit costing, local call costing or preferably charging for data actually transmitted. This is analogous to the postal service: you pay for the data you transit on a unit cost basis. If we don't do that we are going to penalise people who are not close to large centres of population, who are geographically separated, who are only able to transit data slowly over long periods of time. There are problems with copyright, to be identified and settled. We need standard operating systems, to ensure that we have commonalities of systems and able therefore to relate to source libraries and databases and to integrate systems as rapdily as possibly. We need systems of quality control, we need organisations and institutions that are going to guarantee quality and are going to accredit the results of the courses and the materials which are going to be produced.

There should be an educational development agency, but a subtly different one, not totally publically funded. It should be part publicaly funded, it should be part privately funded, it should encourage this activity to be seen as something that is profit centred. This is based on the way that the Japanese are currently funding their Fifth Generation project, with the

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government putting a certain amount of money in, and private enterprise putting money in. The banks and the financial institutions must also be concerned because I would suggest that those aspects of the work that are going to lead to products that are sold on the open market or are sold overseas should be funded as all industrial enterprises are, by looking for venture capital from the standard financial institution. But because this is a very high risk venture, in the first instance most of that money would be guaranteed by the agency so that the banks' risk is less than at this point in time.

There would be other categories of work which the agency would fund either fully or partly: obviously, providing information and advice, providng research support and setting up special programmes where you have got actually to launch something. Get that infrastructure set up, and that is going to be a key element before anything else can take place. The work would actually be done by quite a lot of existing organisations, or perhaps by an extension of these, maybe by one or two new organisations being set up. Regional or national educational development laboratories with again local and national funding coming in. Commercial suppliers and distributors, the hardware companies and the publishers, again with their own money being introduced and I have suggested also industrial training associations. Groupings in fact of like-minded industries or like-minded companes. You can get contributions from existing organisations, universities, training organisations feeding down to the users.

5.3 Professor B. Holmberg (Germany)

When in February I received the original invitation to this conference I agreed to talk about two topics. One was the reasons for using or not using information technology, for using or not using information technology-based systems for education and training, and the second was requirements for future work. Now, the first topic required some very elementary questions and I am afraid I shall be very elementary in my approach. First of all, a general declaration of principle: the misguided euphoria created by previous technological advances should make educators wary of premature conclusions about the blessings of new information technology. Not long ago, many policy makers both amongst politicians and educators declared TV, teaching machines, programmed instruction, to take but a few examples, to be the panaceas of educational problems. Disappointing experiences have taught us, or should have taught us, to apply more discriminating judgement, to would-be cure-alls and gadgets. An educator's starting point must always be the educational needs and potentials, not technology as such. As a warning to ourselves to keep our enthusiasm in check, we should keep an open mind when looking into the possibilities of educational technology.

I am active at a distance teaching university The Fernuniversitat, and should like to pay some attention to two aspects of distance education. They are the presentation of information, that form a one-way traffic on the one hand, ano two-way communication on the other hand. I'm afraid I do not expect very much of new technology, as to one-way communication,

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whereas I hope it will be able to further promote two-way educational communication.

Fist, a few words about the one-way traffic. The value of TV and video recordings for demonstration of laboratory experiments, medical operations and other processes, for which iconic rather than verbal approaches are required can't be doubted. Video disks would seem to offer some possibilities here with their large storage capacity, coupled with freeze-frame and fast search equipment. However, I very much doubt if this applies to verbal messages. At the present time, when the presentation of texts and graphics on a screen instead of on paper is becoming more and more common (think of video text, teletext etc.) we should ask outselves if this is really desirable and if it is, to what extent. Now it is undoubtedly desirable when urgent really new information is provided, that is to say information not available in books or articles. Here the parallel is with information about rates of exchange, plane bookings etc. is illuminating, but in other cases I am inclined strongly to doubt its value. For teaching purposes the presentation of verbal subject matter in print is I sincerely believe, in all respects decidedly superior to screen presentation, it is easier to read, it facilitates leafing and browsing and it is open to all sources available, not only as such that have been deemed suitable by the decision makers for computer storage or even micro fiche presentation. There can be no doubt that for all serious study the reading of printed material will remain a prime medium. Natually in distance education often in combination with audio recordings. I believe that the new information technology can contribute to educational one-way presentation of subject matter and general information by making moving iconic presentations and unprinted data accessible. But further development work should, in my view, be based on the principle that printed material must remain the chief source of verbal knowledge. As to TV and video recordings, systems for 3 dimensional viewing belong to the educational desiderate for example for an engineering subject; that might be something for our technologists to consider.

The situation is very different for mediated 2-way communication. The great weakness of distance education has in most cases been the slowness of communication, the communication process caused by the correspondence method dominating this kind of education. For a student assignment to be sent by the student, received by the supporting organisation, correct, commented on and return to the student so that he or she receives it within a week. This is considered remarkably quick, and it represents a turn around time that many distance institutions and post offices seem unable to achieve. Counselling distance students is subjected to the same delay. So far, telephone communication has been used to overcome this difficult, but in most cases problem solving in writing, essays, translations etc. are the object of communication. The telephone is mainly a supplementary teaching medium and remains so even it is combined with teletransmission of written elements, drawings etc. Now the great exception to this weakness is the Cyclops system introduced by the British Oepn University. It is an extremely versatile audio-visual teaching system, based on the conventional TV set, standard audio cassettes and micro-computer technology. The Cyclops screen can be used for writing and drawing on both by tutor and

students, and the telephone lines are used to relay the writing between the various participants in the tutorial., In the future, viewdata systems may become useful media for interactive teaching by combined use of TV and telephone. Video-disk systems I've already referred to, appear promising as they can allegedly cater, not only for audio and video presentation, but also for interactive teaching by computer programmes. If low cost video-disk applications can be developed, something potentially important will have been contributed.

Traditional on-line computer work, evidently helps to overcome the weakness, that is the slowness, but as so far extremely few students can be expected to have a terminal available at home. Its value is limited to those in conventional face to face education and to those distance students who have study centres within very easy reach. The most common use of the computer I think concerns off-line systems. Off-line use of the computer in most cases causes a reduction in the turn-around time of student assignments, but the students solutions as well as the corrections and comments are sent by mail. It does not lead to immediate communication, it may save a day or two or perhaps a little more. Now this is I believe where new technology could contribute educationally, valuable innovations - combinations of micro-computer technology and telephone communications. The snag that will seem to remain even if a serious of new possibilities for immediate communication of this kind were created is that this communication would have to rely on pre-programmed answers, pre-programmed comments, pre-programmed suggestions. It is true, simulated conversations, simulated dialogue could be brought about, but I don't see how by technological means other than telephone, telefax, telex and Cyclops principles immediate really personal communication could be arranged.

The application of modern text processing of the type used by newspapers maybe applied to bring about rapid correction and other two-way traffic in distance education. Such developments will seem to belong to the most essential endeavours of today, as they would facilitate individual and autonomous learning based on mediated dialogue allowing for critical discussion, that is to say a type of really liberal education irrespective of subject areas chosen. Whatever technological progress is made, two-way communication in writing, inviting scholarly analysis remains a core medium. I was told yesterday by Tony Bates that this is not only our pious wish on my part but that the Open Learning Institute in British Columbia already makes this kind of use of text processing. However, its difficult to foresee if or when in any developed nation the average student can have the necessary equipment for typing and transmission available at home. I think it's essential to stress, what has been said here before that what we need is not only communication with a computer but communication between human beings, and even there information techonlogy could, I hope, be helpful.

Question

You cannot afford new education in the volume you need and the quality you need, so you had better either get the economics of traditional education better, which I don't know how you are going to do it, or you look for ways and means to improve it in another form, and that is what we are discussing, and there ways and means of improving the economics of education and training?

Answer

I don't see that there is any contradiction in what you said just now and my starting point.

5.4 Mr B Lavesen (Denmark)

I started my morning by watching the Open University programme on Art around 1910. A beautiful and useful programme. When you watch such a programme you learn that you can take an object and then you can conceive art from many different aspects. When you have a subject called Future Requirements, Problems and Obstacles, you can also watch that from many different angles. Mr. Huber tried to convince you that this is a question of promoting industry in Europe, he is right. But Professor Holmberg insisted this is a human problem - he is right, and John Duke insisted this is an organisational problem, he is right. Everybody is right, and I am also right when I am saying that it has to do with people. I am a pensioner, principally working with people and I hate bureaucrats. I have made a little guide which covers 80 addresses and telephone numbers of people, human beings, not papers and documents, human being who know about this thing, and I am thinking about them every day. I take this opportunity to thank a lot of people in the United Kingdom because long before it was discovered in the EEC, many years before, they discovered the importance of this subject, and they have been so kind, so open and so helpful, so all of us who have tried to learn the experiences in Britain. When you have a project like this. I have found that it has at least 3 missions, represented by the last 3 speakers. For me there are 2 main missions. One is acceleration of information techonlogy in this society, west of Asia, the other one is acceptance, and I stress acceptance by people. Not only bureaucrats and specialists but also of teachers and students and labouring people and the common man in the street everywhere in Europe.

This is the mission - acceleration of information technology and acceptance by not only the opinion leaders in Europe but at least by 10,000,000 people in this area of the world. When you have clarified your mission, it is quite professional that you clarify your strategy. I cannot help you so much but I can tell you I have found out. There must be two strategies in this. The one is to support existing pioneers, and there are a lot of pioneers fortunately not only in Britain there are pioneers in Western Europe, only a very small part of them are here, but they are sitting all around the place and they should be supported in various ways. Then the other point in your strategy must be to inspire new action, and these 2 points supporting pioneers and inspiring new action must be differentiated and put up in many categories the same way when you paint a picture.

When you have worked through your strategy you have to communicate your strategy and your mission. Not only to the bureaucrats, bureaucratics passes, but also lots of people, politicians in the far corners of the countries. This must also be kept in mind, and this is called modern service management. They have written a lot of books about communicating your mission and your strategy, so you need not sit to work with a pile of playing cards with a back up on most of them. Action comes aftert strategy, I would suggest you file points of action which could be taken. None of them have any new elements. It has all being tried in OECD, in the productivity drive in Britain and its used all over the place and I hope it could possibly be used within the EEC too.

The first one doesn't cost much: You supply all your papers not only with names but also with addresses and telephones, so that you can call one another before a meeting like this and after a meeting like this, and I would suggest that the report from this meeting contains the telephone numbers of everyone here. The second one is to select documentary programmes existing and broadcast them in the various countries. Can be done for low cost. I've seen excellent programmes which are not being broadcast. The next point is mono-lingual conferences, whee you can put people closer together and you do not make the conferences here but put them out in the various countries and also see something in connection with the conference. The fourth point is to institute growing point programme based on the identification adn supporting excellence, excellence in selected areas of information in technology development in the countries. The fifth point is to enter excellence of managerial experience in service management into your action further on. It can be bought very cheaply. Finally, this conference, a mixture of everything without a mission, with a strategy, has nevertheless been useful for me because I have met at least 5 interesting people whom I did'nt know before and with whom I will maintain contact in the future if they want to do so.

5.5 Dr. P. Williams (MEDC, UK)

I now know having listened to all the speakers with great interest, and in the context of the vocational problems that we are looking at, what it is to be redundant. Everything of course that I had intended to say has been said, so as the last speaker there's a very limited amount I could possibly say that is new. I think that we have created for ourselves some problems in that we are looking at the long term, the medium term and the short term simultaneously. I think we should clarify which of the problems can be solved by the short-term emergency action that some people are looking for, and which of these actions could confuse the long-term issues.

In the note I put forward to the meeting in the publication I looked at some of the relatively short-term issues and I think it would be adivsable to either make some decisions on these or to make decisions that we are not making decisions. I think even the latter is aceptable. At the lowest level, are we talking about deciding on a Euro-micro, are we talking about deciding on an operating system under which the software is going to operate, are we talking about a language or a selection of languages that

can be used in the tasks that we are looking at over say the next 2 or 3 years? I think in the disucssion sessions that follow these problems should be discussed and agreed or disposed of. It may well be that the concensus is that these are problems best left to the commercial suppliers, the people with the business acumen, people who can decide what the size of the market is an we might well consider that the educational market is still going to be much smaller than the commercial market and that to accept whatever commercial products are available and to make the best use of them would be a more economical solution than to attempt to design one specifically for our own interests and needs. In that context, I think we should be wary as in any national or international organisation of following a pattern that has been left to us by other well known organisations of the past and present and I refer for example to a definition of the elephant and the elephant is a mouse built to NATO standards. I think we run a risk to involve ourselves in that kind of level if we are not careful. If we look at the successful products over the last 10 years, i.e. the full history of micro-computers, we can see that some of them at least go back to the day of the Apple. The Apple was designed in a garage, the IBM in a skyscraper, now draw your conclusions from that.

We've also talked about the speed of response that is necessary and in any large organisation, inevitably, the speeds can be held down to the speeds of the lowest component of that system. Whether it be the educationalists who are more concerned with arguing or the bureaucrats who are concerned with not implementing decisions because they might lead to problems. We are having to cope with industrial change where the time scale has shortened to less than one year for the development, introduction and making a profit on products, and this applies to both hardware and software in many areas. However, within the educational system it is not impossible to make changes on this timescale. I'm amazed within my own are of activity, and it may either cause panic in the breasts of those present or great joy, that the educational system in Scotland is just implementing changes in the whole of the education for 16 to 18 year olds. It previously did this for 14 to 16 year old group and took 10 years, the present changes will take 10 months, from the time that they have been announced, defined and implemented. Colleges are now receiving the proposals on the courses, in format, the structure, the syllabus, the everything that they will be teaching in August and tyhe documents are appearing on their desk last week, this week and next week. So it is possible for educational systems to change at a rate comparable to the industrial activities around us. That's not to say that the results are necessarily good, but we have had a tendency in the past to assume that educational and training circles will always move at a leisurely pace, whereas industry will race ahead.

The only other small points that I do want to raise, they may seem small to you, they seem relatively large to me, I think that for many speakers there has been an identifgy between words, information technology and computer-based training. I would raise that in your minds that it is only one aspect of information technology and for many of us with our own special interests it may not even be the most important. I'd suggest that the words, like telecommunications, word processing, viewdata, electronic publishing, computer aided design, robotics, industrial control, all have a place in our thinking about the future of information technology in education and training, it is not the future of computer-based training.

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